THE EARLY NEOLITHIC ON THE GREAT HUNGARIAN PLAIN

INVESTIGATIONS OF THE KÖRÖS CULTURE SITE OF ECSEGFALVA 23, COUNTY BÉKÉS

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Investigations of the Körös culture site of Ecsegfalva 23, County Békés

VOLUME I

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CONTENTS

VOLUME I

VOLUME II

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FOREWORD

Eszter Bánffy

Over ten years ago, Alasdair Whittle arrived in Hungary with the intention of investigating a site, which would hopefully shed new light on the transition to the Neolithic. After a few brief site surveys, he decided to choose a Körös settlement because this culture played a crucial, although as yet little understood role in the emergence of the LBK (Linear Pottery culture), the first food-producing culture distributed across the greater portion of the European continent. The choice of the site was influenced by several considerations; it should preferably lie on the northern fringes of the Körös distribution and in an environment which was suited to the life-style of both the assumed Mesolithic foragers and the Körös population. Following repeated field surveys and geological and hydrological samplings, Alasdair chose the Ecsegfalva 23 site lying along an old meander of the Berettyó river. Set in a landscape prone to periodic flooding in the early sixth millennium, this site had initially been identified during the broader area's systemic archaeological field surveys. The excavation conducted jointly by Cardiff University and the Archaeological Institute of the Hungarian Academy of Sciences was begun with the intention of gathering evidence which would shed new light on an Early Neolithic community with a mixed economy based on crop cultivation and hunting, gathering and foraging, as well as on the possible cultural and genetic interaction between local and immigrant populations.

The excavations revealed that the evidence for transition was very scanty indeed. Even though the analyses of the various samples collected from the site's environment showed that subsistence was based on various other activities beside crop cultivation, the archaeological finds and the radiocarbon dates showed that the site did not represent the earliest Körös period, but a slightly later one. However, by the time this fact became apparent, the multidisciplinary investigations and the evaluation of the finds and findings raised a number of other exciting issues, which were at least as important as the original questions the Ecsegfalva project had intended to explore. There was a serious dichotomy between the radiocarbon dates and the chronology suggested by the pottery sample; the pottery uncovered at the site was generally dated to the culture's later phase, whilst the radiocarbon dates assigned the site to an earlier period. Even though the Körös culture is one of the archaeological complexes with a high number of sites and an immense amount of finds, little is known about its internal chronology in spite of the many excavated settlement sites. The current schemes on the culture's internal periodisation often contradicted each other (one case in point being the chronological position of carinated vessels). The investigation of the Ecsegfalva site has yielded new insights regarding the Early Neolithic chronology of the broader region, as well as of the Carpathian Basin and the Balkans, together with new evidence on the region's cultural and other contacts, and on the nature of social changes.

The Ecsegfalva project has contributed much to Neolithic research in other fields too. This Körös site is the perhaps most intensively investigated Neolithic settlement in Hungary. It is quite obvious from the introductory chapter that the multidisciplinary evaluation of the site's environment and its climatic and ecologic conditions, the complex studies on the excavated settlement features and their finds were not exercises for their own sake, but were fitted into a broader research framework. Most of the scholars who contributed to this volume visited the site and participated in the fieldwork, partly in order to form a personal impression of the site. The present volume is the fruit of a broad international co-operation between experts from the United Kingdom, Germany, Austria, the Czech Republic and Hungary, skilfully co-ordinated by Alasdair Whittle. It is our hope that the success of the investigations at Ecsegfalva will inspire other similar projects.

ACKNOWLEDGMENTS

Alasdair Whittle

The project was initiated by my British Academy – Hungarian Academy of Sciences exchange visit to Hungary in 1997. Grateful thanks are due to both institutions, and to Professor Csanád Bálint and Eszter Bánffy of the Institute of Archaeology for all their help and guidance at this and subsequent stages. This visit took me in the first place to County Csongrád. Grateful thanks are due to Ferenc Horváth of the Móra Ferenc Museum, Szeged, for extensive discussion and advice on Körös culture questions. The next area visited was County Békés. Grateful thanks are due to Igor Grin and Imre Szatmári of the Munkácsy Mihály Museum, Békéscsaba, for their help and advice at this stage and later. My 1997 visit also enabled a first meeting with Pál Sümegi, and it is hard to thank him enough for all his contributions to the project over the course of its duration.

Over the winter of 1997–98 a formal cooperation was agreed between the Archaeological Institute of the Hungarian Academy of Sciences, Budapest; the county museum for County Békés, the Munkácsy Mihály Museum, Békéscsaba; and Cardiff University. Thanks are due to Professor Csanád Bálint, Igor Grin and Imre Szatmári for all their help in this regard. A four-year permission was granted for investigations and excavations; the guidance of Katalin Ernyey of the Directorate of Cultural Heritage (Kulturális Örökség Igazgatósága) has been very helpful. The participation in the project of István Zalai-Gaál is also gratefully acknowledged. The support of all colleagues in the Archaeological Institute, Budapest, has been invaluable.

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I am extremely grateful to all the colleagues who have participated in the project and whose dedicated work is represented in this volume. Special thanks go to: Michael Hamilton, for helping to get things going; Krisztián Oross, for helping in so many ways to get things finished; László Bartosiewicz, for dealing with so many questions from me; Rick Schulting, for his help over the three years of excavation, working long days in the field with such enthusiasm and skill, and sharing the drives to and from Hungary; and to Amy Bogaard and Joanna Bending, for their patient on-site flotation programme. Ellen Simmons helped with the latter in 2001. In Ecsegfalva, we had the very welcome support of the mayor, Árpád Szoboszlai, who helped with everything from accommodation in the *vadászház* to mechanical diggers. We are very grateful to the people from the village who both helped and welcomed us; special thanks are due to our house managers, and to the doctor Katalin Kelemen and her husband. Vajk Szeverényi, Szilvia Fábián, Eszter Bechtold, Zsuzsanna Tóth and Borbála Laczkovich of the Eötvös Loránd University, Budapest, helped with interpretation and translation, as well as excavation. Students from Cardiff University helped to carry out the excavations, and special thanks are due to Daniela Hofmann for recording and later on, for invaluable help with editing, and to Maizie Elfin and Shelley Appleton for their management of the finds. Finally, we had the benefit of technical and administrative support in my department from Steve Mills, Bob Jones, Sue Virgo, Aled Cooke, John Morgan and Liz Walker. Howard Mason has prepared the drawings in chapters 1, 9 and 32 for publication, and Tibor Marton those for chapters 27–30; grateful thanks are due to both. Finally, special thanks go to Zsolt Réti for processing and editing of illustrations, and to Gyöngyi Kovács for her expert help with copy editing and proofs.

INTRODUCTION – BEVEZETÉS – EINFÜHRUNG

Alasdair Whittle

This volume presents the results of research on the Early Neolithic Körös culture of the Great Hungarian Plain. Four years of small-scale but intensive investigations were centred on the site of Ecsegfalva 23, Co. Békés. The site lies beside an old meander – the Kiri-tó – of the Hortobágy-Berettyó river, northern tributary of the Körös river system. The site, first recorded by the Hungarian Archaeological Topography, was chosen for its proximity to pollen-bearing sediments in the meander and its position near the main northern limits of the Körös culture.

Within broader questions about the Körös culture and its place in the development and spread of the Neolithic, detailed aspects of environment, settlement and subsistence were the principal goals of the project. Ecsegfalva 23 is part of a distinctive, flat landscape. Other sites are known in the vicinity, around the meander and in former channels of the Berettyó; none are known at present in the depressions to the north, while rather more are recorded on the old alluvial terraces to the south. GIS-based study of the affordances of this landscape (chapter 3) and an account of its history (chapter 4) are followed by detailed investigations of the Kiri-tó meander: the sediments (chapter 5), pollen and phytolith analysis (chapter 6 and 7), and molluscan analysis (chapter 8). Early Neolithic people at Ecsegfalva 23 lived beside the waters of a shallow meander in a landscape probably prone to periodic flooding, surrounded by a mosaic of woodland and open ground.

Ecsegfalva 23 is known from surface finds and geophysical survey to stretch in total some 140 m along the edge of the Kiri-tó, though the main concentration of features occupies only the highest point (chapter 9). Only three small trenches (A, B, C) were excavated, and the largest, Trench B (10 by 15 m) was not fully excavated over its whole extent. In Trenches A and C, probably on the periphery of the occupation, pits were found; those in Trench A were shallow, but contained quantities of carbonised plant remains, and were overlain by a burial of the Alföld Linear Pottery culture (chapter 25). In Trench B, a large pit was overlain by a substantial cultural deposit, rich in finds of sherds, daub, animal, bird and fish bone, shellfish, lithics, fired clay objects and bone tools. Micromorphological analysis (chapter 11) indicates the presence of both animal dung and charcoal, and grasses and other vegetation were also introduced (chapter 24). Much of the deposit consists of ashy material (chapter 11), though it varies chemically across the area uncovered (chapter 12). The deposit is probably the result of both middens and the burning of former structures. Only one posthole was located (though others may remain in the unexcavated portion of Trench B) but study of the daub (chapter 13) shows not only numerous impressions of reeds but also some of posts or wooden components. The pit fill and the stratigraphy may suggest a succession of structures. Radiocarbon dates suggest that occupation began after 5800 cal BC, and was concentrated between 5750–5650 cal BC, probably within a period of 70–80 years (chapter 10).

A very wide range of evidence for subsistence was recovered (chapters 14–23). Although, as at other sites of the Körös culture, a broad spectrum of both domesticated and wild species are represented, the principal animal was the sheep (with some goat) (chapter 14). The status of cattle is uncertain, though five samples analysed for their aDNA indicate wild aurochs (chapter 15). Young animals are represented, indicating settlement in the summer (chapter 14), and study of sheep/goat mandibles shows winter killing of older animals (chapter 16), as well as teeth wear patterns indicative of high stocking levels, perhaps in fairly confined conditions (chapter 17). Sheep/goat were consumed for meat, and there is also evidence from analysis of residues of fatty acids in pottery for the consumption of dairy products as well as of animal fats (chapter 18). Birds, fish and shellfish were also consumed (chapters 19–21), though probably as supplementary food. Bird species include summer and winter migrants. Plant species recovered by flotation of their carbonised remains include glume wheats, free-threshing wheat and barley, one grain of common millet, one grain of lentil, a range of wild seeds/fruits, and a range of weeds including both wild species and ones associated with cultivation (chapter 23). Einkorn, emmer and barley were probably the principal species cultivated. The dominance of annuals in the weed assemblages suggests permanent cultivation plots or gardens. Isotopic study of the AVK burial and the fauna from Ecsegfalva 23, with comparative data from other sites (chapter 22), and the evidence of teeth from Körös and AVK sites on the Great Hungarian Plain (chapter 26), complement these investigations of subsistence.

There was a rich if simple material inventory, dominated by pottery (chapter 27). The abundant pottery included cups, bowls, globular vessels and jars. Decoration was principally by burnishing, slips, impression and incision of various kinds, applications and barbotine treatment. The status of biconical carinated bowls is considered in conjunction with the radiocarbon evidence of chapter 10. A few figural representations were found, along with large clay weights and loomweights (chapter 28). A wide range of bone tools were found (chapter 29). Imported stone material included small axes and two small querns; there were also a few small beads and buttons (chapter 30). Other lithic material was not abundant but included limnnic quartzite, obsidian, radiolarite, Banat and Volhynian flint, and porzelanite (chapter 31), variously from sources to the north and south. Both 'Mediterranean' and 'Danubian' styles of production can be discerned, suggestive of varying cultural traditions and origins.

People lived at Ecsegfalva 23 for perhaps not more than two or three generations, between c. 5750–5650 cal BC. They might have been of mixed descent (chapter 32). They chose to live in a varied, mosaic landscape, perhaps liable to periodic flooding. The settlement was probably small at any one time, and for parts of the year perhaps isolated; larger seasonal aggregations can also be considered. People had structures built of daub, reeds and probably timber. They hunted game and birds, fished, and collected wild plants and shellfish, but their principal concerns were with sheep/goat herding and cultivation of cereals in gardens. The evidence strongly suggests occupation in all the main parts of the year, though it is possible that there were movements out into the landscape according to seasons and tasks. These data are important not only for establishing the nature of the Körös culture in one part of its distribution but also for thinking about the conditions in which the subsequent Linear Pottery culture arose. Not only the technicalities of Early Neolithic existence but also the ways of living well together can be reconsidered in the light of this wealth of new evidence.

* * *

A kötet az alföldi kora neolitikus Körös-kultúra kutatásának újabb eredményeit mutatja be. A Békés megyei Ecsegfalva 23 lelőhelyen négy éven át folytattunk kis felületre kiterjedő, de intenzív vizsgálatokat és ásatásokat. A lelőhely a Körösök vízrendszeréhez tartozó mellékfolyónak, a Hortobágy-Berettyónak egy régi meandere, a Kiri-tó mellett található. A lelőhelyre a *Magyarország Régészeti Topográfiája* program keretében bukkantak; választásunk azért esett rá, mert környezetében pollenben gazdag üledékek regisztrálhatók, és a Körös-kultúra északi határára esik.

A Körös-kultúrára, illetve a neolitikum megjelenésére és elterjedésére vonatkozó általános kérdéseken túlmenően a kutatási program fő célja az egykori környezet, a településtörténet és az életmód részletes vizsgálata volt. Ecsegfalva 23 lelőhely jellegzetes síkvidéki település. Szomszédságában, a meander és a Berettyó hajdani medrei mellett további hasonló korú lelőhelyek fordulnak elő. Az északra elterülő süllyedékekben eddig egyetlen lelőhelyet sem azonosítottak, míg a délebbi ősi alluviális teraszokon több is ismert. A környezet adottságainak térinformatikai feltérképezését (3. fejezet) és a környezet leírását (4. fejezet) a Kiri-tó meander részletes bemutatása követi; az üledékek (5. fejezet), a pollenmaradványok és fitolitok (5. és 6. fejezet), valamint a molluszka fauna vizsgálati eredményeinek (8. fejezet) ismertetésével. Az Ecsegfalva 23 település újkőkori népessége egy sekély vízű meander mellett élt, egy olyan, rendszeres áradásoknak kitett mozaikos környezetben, amelyben erdőségek és nyílt területek váltakoztak egymással.

A felszíni leletek és a geofizikai felmérés tükrében Ecsegfalva 23 lelőhely mintegy 140 méter hosszan húzódik a Kiri-tó mellett, bár a telepjelenségek a lelőhely legmagasabb pontján sűrűsödnek (9. fejezet). Három kis méretű szelvényt nyitottunk (A, B, C). A legnagyobb, 10 × 15 m kiterjedésű B szelvényt nem tártuk fel teljes egészében. Az A és C szelvényekben, amelyek feltehetően a település szélére estek, csak gödröket találtunk. Az A szelvény sekély gödreiből rengeteg szenült növényi maradvány került elő. A gödrök felett az alföldi vonaldíszes kerámia kultúrájának temetkezését tártuk fel (25. fejezet). A B szelvényben kibontott nagyméretű gödröt gazdag kultúrréteg fedte, amelyből számtalan kerámiatöredék, patics, különféle állat-, madár- és halcsont, kagyló, kő- és csonteszköz, illetve égetett agyagtárgy került napvilágra. A mikromorfológiai vizsgálat (11. fejezet) állati trágya és faszén, illetve különböző fűfélék és más növények egykori jelenlétét mutatta ki (24. fejezet). A feltárt rétegsor nagy részét hamus anyag alkotta, bár az a felület különböző pontjain eltérő kémiai összetételű volt (12. fejezet). Kialakulása minden bizonnyal a háztartási hulladék felhalmozódásának és az épületek leégésének tulajdonítható. Egyetlen cölöplyukat sikerült megfigyelni, de elképzelhető, hogy a B szelvény feltáratlan területén további cölöplyukak rejtőznek. A paticstöredékeken nád és facölöpök, illetve egyéb faszerkezetek lenyomatait azonosítottuk (13. fejezet). A gödör betöltése és a rétegsor több egymást követő épületre utal. A kalibrált radiokarbon adatok tanúsága szerint a település Kr.e. 5800 után létesült, és mintegy 70–80 évig volt lakott Kr.e. 5750–5650 között (10. fejezet).

Számtalan lelet utal az életmódra (14–23. fejezet). A Körös-kultúra többi lelőhelyéhez hasonlóan többfajta vad- és háziállat maradványa került elő, melyek között a juh (illetve kecske) volt a leggyakoribb (14. fejezet). A szarvasmarha jelenléte bizonytalan, bár a DNS-vizsgálatok alapján öt minta őstuloktól származik. A fiatal jószágok a település nyári használatára utalnak (14. fejezet), míg a juh/kecske állkapcsok vizsgálata azt bizonyította, hogy az idősebb állatokat télen ölték le (16. fejezet). A fogakon megfigyelt kopásnyomok tanúsága szerint fejlett volt az állattartás, és valószínűnek tűnik, hogy az állatállományt egy meglehetősen szűk, elkülönített területen tartották (17. fejezet). A juhot/kecskét a húsáért tenyésztették. A kerámiatöredékeken megtapadt zsírsav vizsgálata azt is kimutatta, hogy a település lakói tejtermékeket és állati zsiradékot fogyasztottak (18. fejezet). Az étrenden kiegészítő jelleggel szerepeltek madarak, halak és kagylók (19–21. fejezet). A madárcsontok között nyári és téli vándormadarak maradványai egyaránt fellelhetők. A földminták iszapolásából nyert szenült magvak között toklászos búzát, csupasz búzát és árpát, egy kölesszemet, egy lencseszemet, többféle vadon termő magvat/gyümölcsöt és különféle gyomnövényt sikerült felismerni (utóbbiak között egyaránt voltak vadon növő és szántóföldi gyomok) (25. fejezet). A település lakói elsődlegesen alakort és tönkölybúzát, illetve árpát termesztettek. Az egynyári fajták túlsúlya a gyomnövények között állandóan megművelt földekre vagy kertekre utal. Az életmódot, gazdálkodást tárgyaló részeket azok a fejezetek zárják, amelyek az AVK temetkezés és az ecsegfalvi állatcsontok izotópos vizsgálati eredményeit vetik össze más lelőhelyek hasonló adataival (22. fejezet), illetve a Körös-kultúra és az AVK lelőhelyeiről származó fogmaradványokon végzett megfigyeléseket ismertetik (26. fejezet).

Nagyszámú, bár meglehetősen egyszerű, javarészt kerámiatöredékekből álló leletanyag került elő (27. fejezet). A kerámialeletek között leggyakoribbak a tálak, csészék, gömbös testű edények és tárolóedények különféle típusai, melyeket ujj- és körömbenyomkodással, karcolásokkal, besimított mintákkal és bevonattal díszítettek. A kettős kónikus tálak időrendi helyzetét a 10. fejezetben közzétett radiokarbon adatok fényében tárgyaljuk. Előkerült néhány figurális ábrázolás, továbbá nagyobb, agyagból készült nehezék és szövőszéknehezék (28. fejezet). A leletanyagban sokféle csonteszköz található (29. fejezet). Az import kőanyagból készült leletek között két őrlőkő és néhány kisméretű kőbalta volt, de előfordultak apró gyöngyök, gombok is (30. fejezet). A nem túl nagy mennyiségű kőanyagban limnokvarcitot, obszidiánt, radiolaritot, bánáti és volhíniai kovát, valamint porcelanitot sikerült azonosítani (31. fejezet), melyeket északi és déli nyersanyagforrásokból szereztek be. Az eszközkészítésben „mediterrán" és „dunai" hagyományok egyaránt kimutathatók, ami a népesség összetett eredetére és sokszínű kulturális hagyományaira utal.

Az ecsegfalvi település legfeljebb két vagy három generációt átfogó időszakban állt fenn Kr.e. 5750–5650 között. Valószínűnek tűnik, hogy a sokszínű, olykor árvízzel sújtott mozaikos környezetben kevert lakosság telepedett meg (32. fejezet). A település kis kiterjedésű lehetett, és az év bizonyos időszakaiban elszigetelt; elképzelhető, hogy a lakosság száma szezonális jelleggel váltakozott. Épületeik paticsból, nádból és valószínűleg fából készültek. Vadon élő állatokra és szárnyasokra vadásztak, halásztak, vadnövényeket és kagylókat gyűjtöttek, bár elsődlegesen juh/kecske tartásával és a kertjeikben gabonatermesztéssel foglalkoztak. A rendelkezésre álló adatok arra utalnak, hogy a települést az év minden időszakában lakták, bár elképzelhető, hogy az adott évszaknak megfelelő feladatok ellátására időnként elhagyták. Az adatok nem csupán a Körös-kultúra jellegzetességeire világítanak rá az elterjedési területének egy részén, hanem fontos adalékot jelentenek azon körülmények megismeréséhez is, melyek között a vonaldíszes kerámia kultúrája kialakult. Az eredmények új megvilágításba helyezik a korai neolitikus életmód egyes elemeit, és lehetővé teszik a sikeres és harmonikus társadalmi együttélés módozatainak ismételt átgondolását is.

* * *

Der vorliegende Band fasst die Ergebnisse von Nachforschungen über die frühneolithische Körös-Kultur der Großen Ungarischen Tiefebene zusammen. Kleinräumige, aber intensive Untersuchungen konzentrierten sich über vier Jahre hinweg auf den Fundplatz Ecsegfalva 23, Komitat Békés. Der Fundplatz befindet sich neben einem alten Mäander – dem Kiri-tó – des Hortobágy-Berettyó, dem nördlichen Zufluss des Körös Flusssystems. Der Fundplatz, erstmals von der 'Magyarország Régészeti Topográfiája' (Archäologische Topographie Ungarns) erfasst, wurde aufgrund seiner Nähe zu pollenführenden Sedimenten im Mäander und seiner Lage nahe der nördlichen Grenze der Körös-Kultur ausgewählt.

Im Rahmen umfassenderer Fragen über die Körös-Kultur und ihrer Rolle in der Entwicklung und Ausbreitung des Neolithikums standen Detailaspekte der natürlichen Umwelt, Besiedlung und Nahrungsgrundlage im Vordergrund des Projekts. Ecsegfalva 23 ist Teil einer charakteristischen, flachen Landschaft. Aus der näheren Umgebung sind weitere Fundplätze bekannt, und zwar um den Mäander und an Altarmen des Berettyó; in den weiter nördlich gelegenen Senken kennen wir derzeit keine Fundstätten, wohingegen mehrere auf den südlich gelegen alluvialen Terrassen dokumentiert sind. Einer GIS-Studie über die Nutzungsmöglichkeiten dieser Landschaft (Kapitel 3) und einem Überblick über ihre Geschichte (Kapitel 4) folgen detaillierte Untersuchungen zum Kiri-tó Mäander: Sedimente (Kapitel 5), Pollen und Phytolithe (Kapitel 6 und 7) und Molluskenanalyse (Kapitel 8). Die frühneolithischen Bewohner von Ecsegfalva 23 lebten neben den flachen Wassern des Mäanders in einer Landschaft, die wahrscheinlich zu periodischen Überflutungen neigte. Sie waren von einem Mosaik aus Wald und offenem Gelände umgeben.

Oberflächenfunde und geophysikalische Prospektion zeigen, dass sich Ecsegfalva 23 insgesamt etwa 140 Meter entlang dem Ufer des Kiri-tó erstreckt, wobei sich die größte Befunddichte auf die höchstgelegene Stelle konzentriert (Kapitel 9). Nur drei kleine Schnitte (A, B, C) wurden angelegt und der größte, Schnitt B (10 mal 15 Meter) nicht in seiner Gesamtausdehnung vollständig ausgegraben. Schnitte A und C, die wahrscheinlich am Rande der bewohnten Fläche liegen, erbrachten einige Gruben; diejenigen in Schnitt A waren flach, aber enthielten eine Anzahl verkohlter Pflanzenreste und wurden von einem Grab der Alföld-Linearkeramik überlagert (Kapitel 25). In Schnitt B wurde eine große Grube von einer beträchtlichen Kulturschicht bedeckt, die große Mengen an Scherben, Hüttenlehm, Tier-, Vogel- und Fischknochen, Schalentieren, Silex, Gegenständen aus gebranntem Ton und Knochengeräten enthielt. Die mikromorphologische Analyse (Kapitel 11) weist auf die Anwesenheit von Tierdung und Holzkohle hin; Gräser und andere Pflanzen waren ebenfalls in die Siedlung gebracht worden (Kapitel 24). Ein Großteil der Kulturschicht besteht aus aschereichem Material (Kapitel 11), das jedoch in verschiedenen Teilen der freigelegten Fläche chemische Unterschiede aufweist (Kapitel 12). Die Schicht ist wahrscheinlich das Ergebnis sowohl von Abfallanhäufungen als auch vom Verbrennen ehemaliger Gebäude. Nur ein einziges Pfostenloch wurde erfasst (obwohl weitere möglicherweise in den nicht ergrabenen Teilen von Schnitt B verbleiben), aber eine Untersuchung des Hüttenlehms (Kapitel 13) zeigt nicht nur zahlreiche Schilfabdrücke, sondern auch einige Spuren von Pfosten oder anderen Holzkomponenten. Die Grubenverfüllung und stratigraphische Abfolge könnten auf ein Nacheinander von mehreren Gebäuden hinweisen. Radiokarbondaten deuten darauf hin, dass die Belegung nach 5800 cal BC begann und sich wahrscheinlich auf einen Zeitraum von 70 bis 80 Jahren zwischen 5750 und 5650 cal BC konzentrierte (Kapitel 10).

Es wurden umfangreiche Daten zur Ernährungsweise zusammengetragen (Kapitel 14–23). Schafe (und einige Ziegen) dominieren das Faunenmaterial, obwohl, wie auch auf anderen Fundplätzen der Körös-Kultur, ein weites Spektrum von domestizierten und wilden Tierarten vorliegt (Kapitel 14). Die Stellung des Rindes ist in dieser Hinsicht ungewiss, obwohl fünf aDNA Proben auf Wildrinder hinweisen (Kapitel 15). Jungtiere sind vertreten, was eine Nutzung des Siedlungsplatzes im Sommer belegt (Kapitel 14), und Untersuchungen an Unterkiefern von Schaf/Ziege zeigen eine Winterschlachtung älterer Tiere (Kapitel 16). Die Abnutzung des Zahnschmelzes weist auf eine große Anzahl von Tieren pro Herde hin, die vielleicht in relativ beengter Umgebung gehalten wurden (Kapitel 17). Schafe/Ziegen waren Fleischlieferanten, aber Fettsäurerückstände in Tongefäßen haben den Nachweis für eine Nutzung von Milchprodukten und tierischen Fetten erbracht (Kapitel 18). Vögel, Fische und Schalentiere wurden ebenfalls verzehrt (Kapitel 19–21), aber wahrscheinlich eher als Ergänzungen zu den anderen Nahrungsmittelquellen genutzt. Es sind sowohl Sommer- als auch Wintervögel vertreten. Das Schlämmen verkohlter Pflanzenreste erbrachte mehrere Pflanzenarten, wie Spelzweizen, Nacktweizen und -gerste, ein Korn gemeiner Hirse, eine Linse, verschiedene Wildfrüchte und -samen und eine Anzahl Unkräuter, die sowohl Wildarten als auch Ackerunkräuter umfassen (Kapitel 23). Einkorn, Emmer und Gerste waren wahrscheinlich die Hauptgetreidearten. Da unter den Unkräutern einjährige Pflanzen überwiegen, wurden kleine Felder oder Gärten wohl dauerhaft bewirtschaftet. Den Abschluss der Untersuchungen zur Ernährung bilden eine Isotopenanalyse der Alföld-linearkeramischen Bestattung und der Fauna aus Ecsegfalva 23, mit Vergleichsdaten von anderen Fundplätzen (Kapitel 22), sowie Untersuchungen an Zähnen aus Körös und Alföld-linearkeramischen Fundplätzen in der Ungarischen Tiefebene (Kapitel 26).

Das Fundmaterial war reichhaltig, aber einfach, und es dominiert die Keramik (Kapitel 27). Die zahlreichen Keramikformen umfassten Becher, Schüsseln, halbkugelige Gefäße und Vorratsgefäße. Verziert wurden diese meist durch Polituren, Überzüge und verschiedene Eindrücke und Einstiche, Applikationen und Barbotinemuster. Die bikonischen Kielschüsseln werden in Kapitel 10 im Rahmen der Radiokarbondaten behandelt. Es wurden einige figürliche Darstellungen, sowie große Tongewichte und Webgewichte entdeckt (Kapitel 28). Knochengeräte wiesen ebenfalls eine große Vielfalt auf (Kapitel 29). Die importierten Steingeräte umfassten kleine Äxte und zwei kleine Mahlsteine; ein paar Steinperlen und Knöpfe wurden ebenfalls zutage gefördert (Kapitel 30). Andere Gesteinsarten waren selten, aber umfassen Limnoquarzit, Obsidian, Radiolarit, Banat und Volhynian Silex und Porzelanit (Kapitel 31), die aus verschiedenen Lagerstätten in nördlicher und südlicher Richtung stammen. Sowohl „mediterrane" als auch „danubische" Herstellungsweisen sind erkennbar, was auf verschiedene kulturelle Wurzeln und Traditionen hinweist.

Ecsegfalva 23 wurde wohl nicht länger als zwei oder drei Generationen lang aufgesucht, zwischen etwa 5750 und 5650 cal BC. Seine Bewohner waren vielleicht unterschiedlicher Abstammung (Kapitel 32). Sie wählten ein Dasein in einer vielseitigen Mosaiklandschaft, die vielleicht zu periodischen Überflutungen neigte. Die Siedlung war wohl durchweg klein und zu manchen Jahreszeiten vielleicht isoliert; zu anderen Jahreszeiten können auch größere Menschenansammlungen in Erwägung gezogen werden. Gebäude wurden aus Hüttenlehm, Schilf und wahrscheinlich Holz errichtet. Ihre Bewohner jagten Wild und Vögel, fischten und sammelten Wildpflanzen und Schalentiere, aber das Hauptaugenmerk galt den Schaf/Ziegenherden und dem Getreideanbau in Gärten. Alles weist stark auf eine Belegung in allen Hauptjahreszeiten hin, aber es ist möglich dass, je nach Jahreszeit und Tätigkeit, Vorstöße in die weitere Umgebung unternommen wurden. Diese Informationen sind nicht nur bedeutsam, um das Wesen der Körös-Kultur in einem Abschnitt ihrer Verbreitung zu ermitteln; sie fordern auch eine erneute Auseinandersetzung mit den Gegebenheiten heraus, unter denen die nachfolgende Bandkeramik entstand. Im Licht dieser Flut an neuen Ergebnissen können nicht nur die technischen und wirtschaftlichen Einzelheiten des frühneolithischen Daseins, sondern auch die Art und Weise des erfolgreichen Zusammenlebens neu überdacht werden.

Chapter 1

THE AIMS OF THE ECSEGFALVA PROJECT

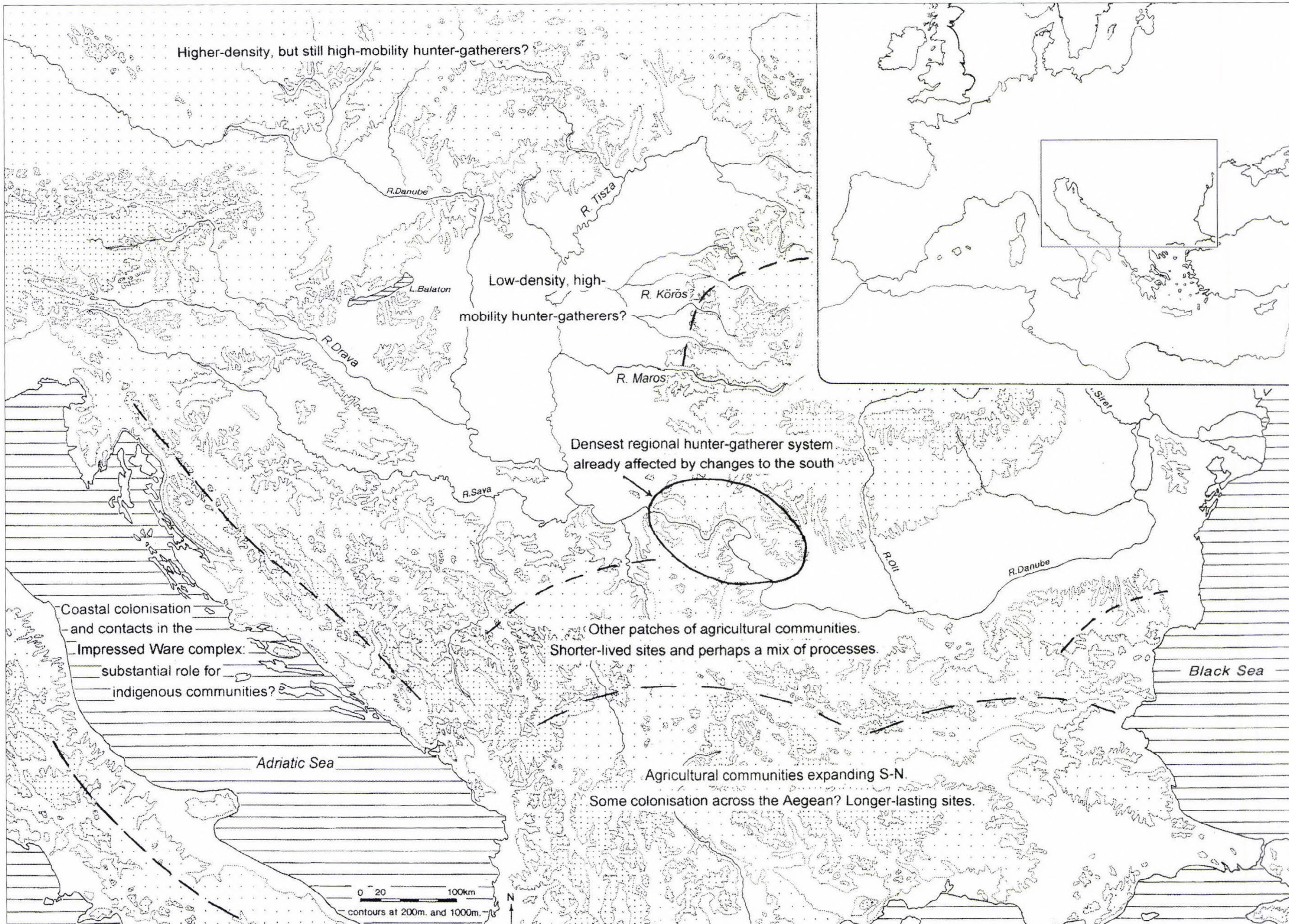
Alasdair Whittle

The Early Neolithic in south-east and central Europe

The Körös culture of the southern part of the Nagy Alföld or Great Hungarian Plain begins about 6000 cal BC (Whittle *et al.* 2002). In conventional terms, it represents the northwards extension of the appearance of the Neolithic way of life, bringing a more settled existence, new material practices, and the use of domesticated animals and plants into the central part of the Carpathian Basin *(Figs 1.1–2).* It is closely related in character to the Starčevo and Criş cultures, the conventional labels for the parallel phenomena in Serbia and Croatia (and now into western Hungary or Transdanubia as far north as Lake Balaton), and Romania respectively. The questions of who was responsible for these innovations, and the processes by which they were brought about, have long been debated in the wider region of south-east Europe as a whole, and the range of opinion expressed in the literature on the Körös culture is sketched below. The dominant model for decades (though there have been both many variants and counter-models) has been of some kind of colonisation by new people from the south, 'demic diffusion' beginning in the seventh millennium in Greece and Bulgaria and fuelling a steady northwards spread over subsequent centuries.

Three aspects of this debate therefore emerge as of especial importance: the beginnings of the phenomenon, the actors and processes involved, and the nature of the new way of life being introduced. Assumptions about all three are closely intertwined. New practices are associated with new people. This combination is usually seen as linked above all to domestication and agriculture, and it is the appearance and spread of farmers, with their proclivity and need to settle down, which take centre stage. Farmers can then be contrasted with foragers. Many, perhaps most, such explanations have thus been in 'essentialist' terms. János Makkay, as just one example, discussing the beginning of the Körös culture, has written in terms of the 'dynamics of the introduction of farming' and of 'the beginning of the food producing economy', as well of the preceding 'Mesolithic way of life' (Makkay 1996, 38, 40). Even recent research on the possible genetic histories of those involved, based on mitochondrial DNA (Sykes 1999) and Y-chromosomes (King and Underhill 2002) respectively, is not free of such powerful underlying assumptions. Results from these studies have been highly important, suggesting a very considerable input from indigenous populations (Sykes 1999; King and Underhill 2002), but it is still insufficient to know that such-and-such a population was composed of say 80 per cent indigenous stock and 20 per cent incoming people. What is important is better understanding of the ways of life and identities which *emerge* from such comings together. More fluid characterisations of all the actors and activities involved may help to challenge this perspective (e.g. Tringham 2000a; Borić 2005; Kotsakis 2005); this point is picked up in discussion throughout this volume.

Alongside what has been called the 'impenetrable whodunnit' of the identity of the people involved (Halstead 1989, 24), the process of settling down and the nature of strategies for making a living may seem a little more open to resolution by sustained research. One way into this


Higher-density, but still high-mobility hunter-gatherers?
R.Danube
R. Tisza
L.Balaton
Low-density, high-mobility hunter-gatherers?
R. Körös
R.Drava
R. Maros
Siret
Densest regional hunter-gatherer system already affected by changes to the south
R.Sava
R.Olt
R.Danube
Coastal colonisation and contacts in the Impressed Ware complex: substantial role for indigenous communities?
Other patches of agricultural communities. Shorter-lived sites and perhaps a mix of processes.
Black Sea
Adriatic Sea
Agricultural communities expanding S-N.
Some colonisation across the Aegean? Longer-lasting sites.
0 20 100km
contours at 200m. and 1000m.
N

aspect of our questions is to take a broader chronological view, beginning a millennium or so after the beginning of the Körös culture, and then reviewing progressively earlier situations. In recent discussions of these problems, a distinction has recurrently been made between the fifth millennium cal BC and what came earlier; sometimes the chronological transition in question is set a little earlier, in the later or even the mid sixth millennium cal BC. Thus Chapman (2000, 3, 234–43) has suggested, by way of an organising generalisation, the sequence from Mesolithic, to early farmers, to mature farmers, to the climax Late Neolithic/Copper Age. While dates are obviously not identical everywhere, mature farmers in this schema belong largely to the fifth millennium cal BC, including in the conventional terminology the social networks of the Karanovo III–IV, Vinča, AVK (short for 'alföldi vonaldíszes kerámia kultúrája', and used thus throughout this volume), Dudeşti, Boian and Hamangia cultures or groupings (Chapman 2000, table 1.1). They can be characterised by settlement 'densification' in already settled core areas, settlement expansion including to neighbouring uplands, and more sedentism, in the form of both tells and so-called flat sites (Chapman 2000, 226). By 4800 cal BC, tells were widespread in Thessaly, Macedonia, and Bulgaria, and sporadic in Serbia, Slavonia, Bosnia, Transylvania and Oltenia, and were emerging, from perhaps late AVK or Szakálhát beginnings, in the eastern part of the Hungarian Plain in the Tisza and Herpály groups; their appearance can in general terms also be seen as coinciding with the building of larger and more complex houses (Chapman 1997a). By the mid fifth millennium cal BC, in 'climax' situations, there was considerable diversity in the nature of places and occupations in the landscape (Chapman 2000, 229).

Another recent discussion has further characterised these developments as 'accelerations' of particular activities to do with crops, animals and building, leading to more permanence of occupation, the creation of boundaries around sites, the building of spatially more complex houses, and the emergence of restrictions and tensions in the landscape and its settlements; the transition from earlier time is here set at about 5500 cal BC (Bailey 2000, 180).

While there are real uncertainties about particular cases within this broad situation, such as whether the AVK before the Szakálhát phase (and so perhaps from 5500 cal BC onwards) can still be seen as less established, given the proof of the existence of AVK longhouses in the northern part of the Plain (Domboróczki 1997), and while the permanence of occupation of all tells and flat sites may still be questioned (e.g. Whittle 1996), here are clear views on when fully settled existence had come into being. What then of earlier times, before 5000 or 5500 cal BC?

One recent characterisation of the Early Neolithic in Greece, beginning in the seventh millenium cal BC, includes an imposed, domesticated subsistence economy, and a high diversity of places and occupations ranging from permanent sites to transient camps (Perlès 2001, 172, 176). Whether such features really go back to the beginnings is a matter for debate (cf. Kotsakis 2005), but it is indeed possible that things were different this far south, especially in the atypical region of Thessaly. Further north, a variety of new practices involving commitment to domesticated crop cultivation and animal herding has been suggested (Bailey 2000, 132–3, 146), along with diversity in surface-built structures and pit-huts, these aggregations perhaps reflecting 'communities of varying densities, sizes and durations' and the 'attachment of communities to place over both short- and long-term residence' (Bailey 2000, 74). In a little more detail, a mosaic of practices has been suggested across Bulgaria, Romania, Serbia and Hungary (Tringham 2000a). Regional variability has been stressed, between the southern Balkan peninsula on the one hand and the catchment area of the middle and lower Danube basin in the northern Balkan peninsula on the other, the latter area lacking evidence for long-term occupation (over more than a few years), even if occupation was year-round, any quantity of solid surface houses, internal spatial

◄ *Fig. 1.1.* Outline interpretive sketch of the broader situation in south-east Europe down to c. 6200 cal BC differentiation within settlements, or extended modification of the landscape (Tringham 2000a, 24–5). 'Tactical', short-term opportunism is taken to characterise the settlement pattern, and as seen in modest exploitation of large forest mammals, there may have been relative under-use of available resources (Tringham 2000a, 25). In particular situations, such as the Danube Gorges, interactions between incomers and indigenous people may have resulted in radical transformations of both sets of actors (Tringham 2000a, 45; Whittle *et al.* 2002; cf. Borić 2005).

What emerges from these discussions is the likelihood of considerable diversity in the times before 5500 cal BC, and it is in this broader context that the wider significance of the Körös culture is to be found.

Körös culture questions: an introduction to the Körös world

General features and questions: interim characterisations

Within the wider setting described above, there are several immediately striking features of the Körös culture of the southern part of the Great Hungarian Plain, on the northern limits of a Neolithic presence around 6000 cal BC and on into the earlier sixth millennium cal BC. The appearance of the Körös culture appears to represent the colonisation, infill or more regular use of what could have been earlier largely an 'empty quarter' (Makkay 1996). The northern limit of the Körös culture is notable indeed, with occupations known from the Tisza valley around Szolnok and roughly east from there across the Plain, but not with any frequency further north, except in the north-east of the Plain (Starnini 1994a; 1994b; Kertész and Sümegi 2001): for new discoveries further up the Tisza, see discussion in chapter 32). Occupations appear from repeated surveys and excavations to be predominantly waterside, to be found variously along the watercourses of the Tisza, Maros and Körös rivers and their tributaries (Kosse 1979). From surface survey data especially, these occupations often appear to be long strips or ribbons, close to the watercourses and confined to the levées, ridges and terrace edges flanking these (Ecsedy *et al.* 1982; Jankovich *et al.* 1989). Where investigated by excavation, relatively thin stratigraphies have been found, and definite evidence for 'houses' or post-built structures has been infrequent, though burnt daub is normally abundant, some house plans are known, and there are house or structure models (Trogmayer 1966; Selmeczi 1969; Raczky 1983a). From an early stage of excavations, and even with the recovery methods available in the 1920s and 1930s, it was clear that people had used a wide range of resources at this time, including fish, shellfish and wild game, alongside domesticated animals and cultivated cereals (Banner 1937; Trogmayer 1968a; Kosse 1979; Bökönyi 1992a; Takács 1992). It was also clear that Körös culture occupations were rich in finds, both from spreads of material above the subsoil where not destroyed by the plough and in the fills of often very large pits cut into the subsoil. This material culture, including fine and coarse pottery in prolific abundance, clay weights, and bone and stone tools, shares elements with other groupings to the south, east and west, though it also has its own distinctive character, especially a general lack of painted pottery and a very restricted lithic repertoire dominated by limnoquartzite and obsidian imported from the hills on the northern fringe of the Carpathian Basin (Makkay 1981; 1996; Starnini 2000; Starnini and Szakmány 1998).

The questions therefore abound. What was the use of the Great Hungarian Plain, or better the drainage system of the Tisza, before the Neolithic? Where did the people of the Körös culture come from? What was the nature of settlement and subsistence in this area at this time, and how can these dimensions best be characterised? What were the major characteristics of the physical environment? And beyond these questions, but inextricably linked to them, what can be said about the nature of social existence, of identity and of worldview in the Körös culture? In what sense was the Körös culture a meaningful grouping, what was distinctive about it, and how did it fit into the wider pattern of change through time?

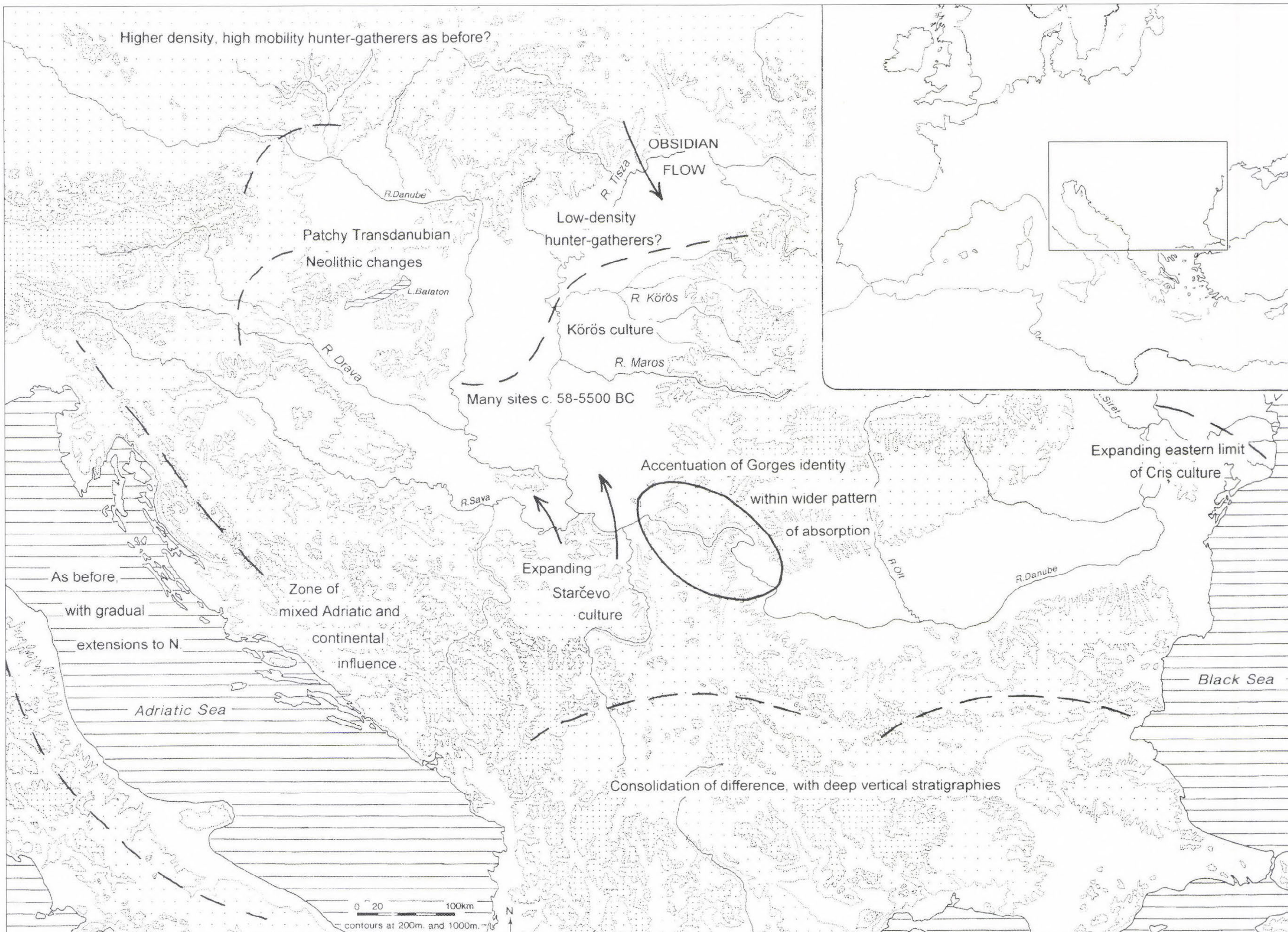
A brief history of main lines of research

These ambitious but important questions can be put into better perspective by briefly noting selected aspects of the history of research (and see also Oross, chapter 27). The Körös culture (c. 6000–5500 cal BC) of the southern half of the Great Hungarian Plain has been quite intensively, if episodically, investigated since the 1920s. The first synthesis was provided by Banner (1937), though the question of relative chronological position remained problematic; still in the early 1940s János Banner saw the Körös culture as a local variant of the Bandkeramik (Banner 1942, 14). The first major, formal treatment was by Kutzián (1944), who listed some 91 sites, with a further 13 possible ones known to her only through the literature. She now put the Körös culture firmly at the start of the Neolithic sequence (Kutzián 1944, 132). Later synthesis by Trogmayer (1968a) noted 156 sites, a number greatly extended by the surveys of the Hungarian Archaeological Topography (Ecsedy *et al.* 1982; Jankovich *et al.* 1989; 1998) *(Fig. 1.2).* Since by the time of Ottó Trogmayer's work, principally on sites in the south of the Plain around Szeged, the correct chronological position of the Körös culture at the beginning of the Neolithic had long been recognised, attention shifted to internal periodisation and to relations with other groups and cultures (Trogmayer 1968c; 1968a; cf. Makkay 1981; Garašanin 1982; and see Oross, chapter 27).

There have been outstanding initial regional surveys which have mapped the distribution of Körös sites against the main elements of the physical environment (Kalicz 1957; Kosse 1979; Ecsedy *et al.* 1982; Sherratt 1982a; 1983a; 1983b; Jankovich *et al.* 1989; 1998). There have been many excavations of varying but mainly limited extent. Two of the largest areas opened have been at Hódmezővásárhely-Kotacpart (Banner 1932; 1934; 1935) and Endrőd 119, the latter reaching 2500 square metres (Makkay 1992). Such excavations have not all been published in full (Makkay 1996, 36, n. 5). Excavations have taken place principally in the general area of the Tisza–Maros confluence in the south (Banner 1932; 1934; 1935; 1937; Trogmayer 1968c; 1968a), but also in the Körös river system itself (Makkay 1980; 1981; 1992) and in the Tisza valley around Szolnok near the apparent northern edge of the Körös culture distribution (Raczky 1976; 1977; 1982; 1983a). Both surveys and excavations are discussed further below, and throughout this volume. At this point we need note only the rather general nature of many of these surveys, the limited extent of most excavations, and the almost universal lack in excavation of sieving as a control on the recovery of small animal and fish bones, carbonised plant remains and other small artefacts.

The Mesolithic question

Some early claims for Mesolithic assemblages around Szeged were made (Hillebrand 1925), but in his syntheses, Banner was curiously unconcerned with what had come before (e.g. Banner 1937). Once the general chronological position of the Körös culture had been settled, the question of a Mesolithic presence on the Great Hungarian Plain became problematic. Kutzián discussed the question rather briefly, seeing a 'breach' between a sparse Mesolithic presence and the beginning of an intrusive Neolithic on the Great Hungarian Plain (1944, 32). Trogmayer (1968a, 13) followed Banner in stressing the varied and broad resource base (seeing hunting, fishing and collecting as very important alongside herding, and cultivation as a minor activity), as well as the short-lived nature of the settlement system of the Körös culture (Trogmayer 1968a, 12). Whereas colonisation seemed to him the best explanation from Macedonia southwards, further north he


Higher density, high mobility hunter-gatherers as before?
OBSIDIAN
FLOW
R. Tisza
R.Danube
Low-density
hunter-gatherers?
Patchy Transdanubian
Neolithic changes
L.Balaton
R. Körös
Körös culture
R. Drava
R. Maros
Many sites c. 58-5500 BC
Siret
Expanding eastern limit
of Criş culture
Accentuation of Gorges identity
within wider pattern
of absorption
R.Sava
R.Olt
R.Danube
Expanding
Starčevo
culture
As before,
with gradual
extensions to N.
Zone of
mixed Adriatic and
continental
influence
Black Sea
Adriatic Sea
Consolidation of difference, with deep vertical stratigraphies
0 20 100km
contours at 200m. and 1000m.
N

gave much greater credence to the acculturation and adaptations of a local population (Trogmayer 1968a, 18–19). In this view, he took the physical anthropology of Körös culture skeletons into account, rejecting the east Alpine model of Nemeskéri to suggest a mixture of Mediterranean and other physical types (Trogmayer 1969, 15). Opinion on this issue has been very divided. Farkas (1977) saw the population as southern or south-eastern in origin and type, while Zoffman (1986) was later to assert the homogeneity of the Körös culture population, on the basis of the very small sample available from the main part of the Great Hungarian Plain itself.

A considerable body of opinion has inclined to the model of immigrant populations, though with varying allowance for local contributions (e.g. Kozłowski 1982; Raczky 1988; Kalicz 1990; Starnini 2000; 2001). A view in many ways more akin to that of Trogmayer has been set out by Makkay (1996), partially in the light of the discovery of Mesolithic sites in the Jászság north of Szolnok (Kertész 1996). The wider difficulties of finding the Mesolithic of the Plain were repeated (Makkay 1996, 40). A model was suggested of the probability of some kind of demic diffusion from the south, checked in its northwards spread by Mesolithic populations, possibly along some kind of 'ancestral ethnic border' going back into the Palaeolithic or some kind of dialect border (Makkay 1996, 41). A possible explanation of the northwards limits of the Körös culture in climatic and ecological terms has also been explored (Kertész and Sümegi 2001; Sümegi and Kertész 2001). Interaction between incomers and indigenous populations has also been considered from the lithic point of view (Mateiciucová 2001), and indigenous population has been given predominant weight in interpretation of patterns in mitochondrial DNA (Sykes 1999; cf. King and Underhill 2002).

The setting and settlement

From an early stage it was possible to stress the placing of most known sites near water but above the likely flood levels suggested by historical maps, and to correlate the many finds of *Unio pictorum* with the presence of still water; water was seen to provide opportunities for subsistence, including the communal activity of net fishing, and for communication and exchange (Banner 1937, 33, 44). Later studies, for example in the Tiszazug area of the Tisza–Körös confluence (Kalicz 1957) and in the Körös and Tisza valleys generally (Kosse 1979) were able to map the relationship of Körös culture sites to the levées of former water courses and to the distribution of soils. In the latter study, the very high numbers of Körös culture sites close to water were confirmed, a relationship further indicated by recurrent finds of fishbone and the clayweights conventionally interpreted as netsinkers (but see chapters 9 and 28). The Tiszazug remained the principal detailed case study within the broader distribution (e.g. Kosse 1979, fig.13). By the early 1980s, Andrew Sherratt was able to use the survey data about to be published by Ecsedy *et al.* (1982), supplemented by further survey north of Dévaványa (Sherratt 1982a; 1983a; 1983b). Here the pattern, in one of the lowest parts of the tectonic depression that the Plain constitutes, was of linear occupations, of varying extent, along the edges of alluvial islands above the flood plain of a large alluvial delta flowing into the Körös river system. In a more summary, regional, account (Sherratt 1982b, 16), Körös culture settlement was summarised as 'linear settlements up to kilometre or more in length, along the levees of old watercourses'. The 'riverine emphasis' was also stressed, with the exception of a group around Orosháza, with sites along bluffs overlooking narrower floodplains and on small islands in broader floodplains (Sherratt 1982a, 303). In the specific context of the Szeghalom survey within the Dévaványa plain or alluvial delta, shoreline sites on the bluffs of large alluvial islands overlooking the floodplain were again emphasised

◀ *Fig. 1.2.* Outline interpretive sketch of the broader situation in south-east Europe from c. 6000 to c. 5500 cal BC

(Sherratt 1983a, 33). In other summary accounts of Körös culture settlement, there is reference to 'preferential occupation of river- and stream-side locations' and 'successive occupations alongside active river channels' (Chapman 1997a, 149–50), and to 'small open settlements both near and set back from the main watercourses' (Chapman 2000, 148). It may be possible now to refine these initial (and undoubtedly correct) general characterisations.

Until now, it has also been necessary to use very general models for vegetational development on the Plain itself. Banner (1937, 33) proposed a mixture of open meadows (*freigebliebene Weiden*) and oak and elm woods. Rather more detailed sequences became available in the far north-east of the Plain, well beyond the limits of Körös culture settlement (summarised in Járai-Komlódi 1966; Kosse 1979; Willis 1997). The only pollen sequence from the southern part of the Plain itself was a truncated profile probably of 'Atlantic' age from Alpár just west of the Tisza river in Co. Csongrád; mixed forest with oak and elm was suggested, with high counts of alder and an AP count of 74% (Járai-Komlódi 1966; Kosse 1979, 64, fig. 8). More recently, a radiocarbon dated pollen sequence was obtained on the northern edge of the plain at Tarnabod, Co. Heves, with another in the edge of the hills close by at Sirok (Gardner 1999a; 1999b), again well beyond the limits of Körös culture settlement; at Tarnabod, the Neolithic environment was probably rather open (Gardner 1999a, 119). Until now, this lack of information specific to the area of the Körös culture has made it impossible to discuss in detail the impact of the first agricultural intake of the southern part of the Plain. It has been suggested that in south-east Europe as a whole this was very limited in the first stages of the Neolithic (Willis and Bennett 1994; Willis 1997), though it was noted in the study of Tarnabod that the existence of already open environments could have reduced the necessity for any substantial Neolithic clearance (Gardner 1999a, 119), while at Sirok contemporary effects took the form of changes in woodland composition, perhaps the result of coppicing and other management (Gardner 1999b, 178).

The Early Neolithic experience

Finally, it is important to rehearse the fact that most research to date on the Körös culture, and on related phenomena, has been in the technical terms of chronology, cultural affiliation and origins, subsistence, and settlement. Relatively little explicit attention has been given to the nature of daily lives, the character of routine experience, or their relationship to the worldview of the people concerned, such as can be found for example within the dwelling perspective and the concept of the taskscape on the one hand (e.g. Ingold 1993; 2000; Harris 1998; 2000), and within discussions of identity on the other (e.g. Brück 2001; Fowler 2001; 2004; Whittle 2003).

There has been one important and still inspiring exception. After a series of significant but largely descriptive reports on early fieldwork on Körös culture occupations around Szeged, Banner published a synthetic ethnology of the Körös culture (1937). This must reflect his initial training as an ethnographer (Eszter Bánffy, *pers. comm.*). In general, what is attractive is the systematic way in which Banner reviews the material culture and social practices of the Körös culture, imaginatively seeking out their possible significance. The example of net fishing as a collective activity has already been noted above, and his interest extended to clothes, body decoration, and hairstyles (Banner 1937, 36), dance and music (1937, 41), and rites of passage (1937, 43), as well as to the collectivities and socialities of animal herding, housebuilding, and hunting (1937, 44). In one particularly forward-looking passage, Banner (1937, 42) conjured up the following picture of people living in close contact with their surroundings and deeply affected by them:

> „Das Einschlagen des Blitzes, die scheinbar ohne Ursache in Brand geratene Hütte, der im Wasser ertrunkene, oder auf der Jagd gefallene Mann, oder Knabe, die Mutter, die bei

der Entbindung ihr eigenes Leben einbüsst, die Leiche des wachsgelben Greises, der immer herumschleichende, sich fortwährend erneuernde Mond, die systematisch zurückkehrende Sonne, der Wechsel der Jahreszeiten, stellten den Menschen, der auf einer niedrigen Stufe der Natur stand, vor unbegreifliche Dinge, so dass er ein unberechenbares Lenken eines höheren Wesens fühlen musste."

The lightning strike, the hut blazing apparently without reason, the man or boy drowned or killed in the hunt, the mother who forfeits her own life during childbirth, the corpse of the wax-yellow old man, the perpetually revolving, self-renewing moon, the systematic return of the sun, and the change of the seasons, all confronted people, who occupied a low position in nature, with inconceivable things, so that they must have felt an incalculable influence of a higher being (translation by Daniela Hofmann).

Whether one accepts this characterisation or not, the range of interpretation on offer is inspirational, and it is one of the aims of this report, alongside the specific goals described below, to try to emulate this approach.

Project aims and methods

Within the context of these broader results and remaining questions, the primary aims of the Ecsegfalva project were to contribute to better understandings of the physical environment, subsistence, and the character, periodicity and duration of settlement in the Körös culture. We did not intend this in the first place to be a broad study of the Körös culture as a whole, but rather to be detailed initial research in one location, with possible implications for the wider phenomenon, as just discussed with reference to Banner and others. We accepted from the outset that the area of excavation would in the first instance be necessarily very limited by modern standards, given first the duration of the project permission and the grants available, and secondly our desire to achieve close stratigraphic control, detailed recording of finds, and extensive dry sieving allied to a programme of selective water sieving. Wider excavation with these methods is clearly both desirable and necessary, as part of the next stage of research on the Körös culture.

Our choice of location was to be determined by the combination of known Körös culture occupations and deposits or sediments which might provide high-quality palynological evidence. On the one hand, Körös culture occupations were of course well known, both from general synthesis, such as already provided by Kutzián (1944) and Kosse (1979), and other regionally-specific surveys and investigations, such as already noted above. On the other hand, as also already noted above, there was no detailed knowledge of the Holocene vegetational and hydrological sequence in the main part of the Alföld. We decided to concentrate a search for deposits which could give evidence of these sequences on the meanders or oxbows of former river channels, where still-water conditions might be expected in at least parts of the Holocene sequence.

Having chosen a suitable location, our aim was to sample a known Körös culture occupation, exploiting the richness of preservation to recover a broad suite of evidence for subsistence resources and activities, and using fine excavation to give detailed knowledge of stratigraphy and dating of archaeological features. We expected, following the experience of Trogmayer around Szeged, and of Makkay around Gyomaendrőd, for example at Endrőd 119 (Makkay 1992), that this would involve principally the detailed examination of pits and their filling, though occupation features and deposits above the subsoil had been encountered, including in the Tisza valley near Szolnok (Raczky 1976; 1977; 1982; 1983a). We never intended to uncover a large area of an occupation, though we hoped that detailed investigations could contribute to better understanding of the duration, sequence and perhaps cycle of settlement in the Körös culture.


Lake
Balaton
R. Danube
R. Tisza
HUNGARY
R. Hortobágy-Berettyó
R. Koros
0
10 km

Finally, we hoped that detailed investigation of one situation within the Körös culture could contribute to better understanding of the wider questions of beginnings, identity, lifestyle and development, already discussed above, from which the project arose in the first place.

Further detail on field methods is given in the appropriate chapters below.

Development of the project

Distributions and details of known Körös culture occupations had been provided by the surveys of the Hungarian Archaeological Topography for two parts of Co. Békés: the Szeghalom district, covering an area from the Sebes-Körös river and its older course the Holt-Sebes-Körös in the area of Vésztő north-west to Dévaványa to the Hortobágy-Berettyó river near Ecsegfalva (Ecsedy *et al.* 1982); and the Szarvas district, covering an area from the Hortobágy-Berettyó river south of Túrkeve southwards to the Hármas-Körös around Gyomaendrőd and a little further west Szarvas itself (Jankovich *et al.* 1989). These two areas contained important sites and locations previously investigated, including north of Dévaványa (Sherratt 1982a; 1982b; 1983b), around Gyomaendrőd, especially south of Endrőd (Bökönyi 1992a; Makkay 1992; Starnini and Szakmány 1998; and references), and around Szarvas itself (Makkay 1981; Jankovich *et al.* 1989; Starnini and Szakmány 1998; and references) *(Fig. 1.3).* Here then was an area of proven potential for renewed investigation of Körös culture questions, and a preliminary visit in 1997 led to the necessary arrangements and agreements (see Acknowledgments above).

In the summer of 1998 the author and Michael Hamilton undertook geophysical survey (see Hamilton, chapter 9) at a series of known Körös culture sites adjacent to meanders in the former courses of the Körös and Hortobágy-Berettyó rivers: at Furugy south of Békésszentandrás and east of Szarvas, both next to old meanders of the Körös river; and just south of Ecsegfalva, next to the old meander of the Hortobágy-Berettyó river, known locally as the Kiri-tó (or Kiri lake).

Concurrently with this, and running into the winter of 1998, Pál Sümegi and colleagues undertook coring of meander deposits. The core recovered by Sümegi and colleagues from the complex meander at Furugy was shown by Kathy Willis to have insufficient pollen preserved in its sediments for the purposes of the project. The upper part of the sediments in the great meander east of Szarvas has unfortunately dried out, and the stratigraphy of the deposits in the meander close to the Hortobágy-Berettyó south of Túrkeve appeared to be disturbed (Pál Sümegi, *pers. comm.*). However, the sediments in the Kiri-tó meander just south of Ecsegfalva appeared to be intact, despite a small drainage channel, presumably of nineteenth-century origin, cut across the southern side of the southern arm; and it proved possible to extract a full sequence of pollen from them (see Sümegi and Molnár, chapter 5, and Willis, chapter 6). The Hungarian Archaeological Survey had mapped five Körös culture sites in the immediate vicinity of the Kiri-tó (Ecsedy *et al.* 1982) (see *Fig. 9.6*).

We therefore decided to concentrate investigations on this situation. In relation to the history of Körös culture research and to the wider picture discussed above, the eventual, fortuitous choice of this location has been very important, since it gave a micro-region close to the northern limit of the Körös culture, and in a topographic setting different in detail to that of Dévaványa immediately to the south and of Gyomaendrőd and Szarvas further south and south-west. This setting is described and discussed in more detail in the next chapter.

The 1998 geophysical survey had covered Ecsegfalva sites 16, 18, and 23 (Ecsedy *et al.* 1982), showing the presence of magnetic anomalies in each and suggesting the likely existence

◄ *Fig. 1.3.* Körös culture sites in the areas of County Békés mapped by the Hungarian Archaeological Topography programme (after Ecsedy *et al.* 1982 and Jankovich *et al.* 1989) of pits and other features. These are also described further below. Site 16 faces the northern arm of the Kiri-tó. Since the coring had taken place in the southern arm of the Kiri-tó, directly opposite site 18 and only some 600 m north-west of site 23, we decided to begin test excavations in 1999 on sites 18 and 23. Geophysical survey had shown the existence of small, discrete clusters of magnetic anomalies along the ridge overlooking the Kiri-tó which constitutes site 18; Körös culture finds are recorded from here, along with AVK material (Ecsedy *et al.* 1982), and very small quantities of both were observed as surface finds during geophysical survey in 1998. In the event, the anomaly cluster chosen for test excavation in 1999 proved to have only AVK sherds in it; there was no occupation layer as such preserved, and the preliminary indications were of plough damage to a depth of 30–40 cm. By contrast, the geophysical survey of 1998, extended and completed in 1999, indicated a much denser concentration of magnetic anomalies for over 100 m along the southern edge of the southern arm of the Kiri-tó at site 23, and in the larger part of the site then under lucerne a considerable quantity of Körös culture sherds, daub and some obsidian was observed; only Körös culture material had previously been recorded from this location (Ecsedy *et al.* 1982).

We therefore concentrated a greater effort in 1999 on Ecsegfalva site 23, which proved from the outset to be not only rich in finds but remarkably well preserved for an occupation of this kind. Two trenches were begun in 1999. 23A was completed in 2000. 23B was continued into 2001, its area being extended in that season. A third sondage, 23C, was investigated from 2000–2001. These three trenches were small, but provide an initial and carefully investigated sample at intervals along the length of the occupation.

A second core was taken from the Kiri-tó immediately opposite and close to site 23B in the winter of 2000–2001, but its sequence (described by Willis, chapter 6) has proved to be less extensive than that of the first. Geophysical survey was also made of sites 21 and 20 (described below), to the west of 23 along the southern arm of the Kiri-tó. Site 21 appeared partially disturbed by modern features. Site 20 showed a small concentration of magnetic anomalies, though its position made it less useful for the immediate purposes of this project.

Finally, the site was put into a wider context, firstly by local surface survey carried out in 2000 (Hofmann, chapter 9), and by a GIS survey, keyed by a detailed local topographical survey into a wider interpretation of the landscape over an area of 24 by 16 km (Gillings, chapter 3).

Chapter 2

THE SETTING: ECSEGFALVA AND KÖRÖS CULTURE SITE LOCATIONS

Alasdair Whittle

Ecsegfalva and the Kiri-tó meander: the local setting

Ecsegfalva 23, with other sites known from surface survey (Ecsedy *et al.* 1982), lies on the outside levée of a very large old meander, known locally as the Kiri-tó, of the Hortobágy-Berettyó river, which runs south-west to join the Körös river system. Two other sites (20, 21) are found on the outside levée at a distance of hundreds of metres, while two more (16, 18) are known from the uninterrupted inner side of the meander *(Fig. 9.6).*

Fig. 2.1. View of the Kiri-tó from Ecsegfalva site 23

The Kiri-tó is a massive feature, nearly 3 km long, with its channel in places up to 100 m broad and more, enclosing an inner area itself in places over 1 km across across *(Fig. 2.1; Fig. 4.3).* At the present time, the sides of the meander rise some 2 m and more above the level of the infilled channel. As discussed by Sümegi and Willis (this volume, below), the Kiri-tó appears to be of Pleistocene origin; presumably because of either tectonic depression (Sherratt 1982a) or river change in the late Pleistocene or Early Holocene, the meander became a cut-off or oxbow lake by the Early Holocene. Still water is indicated by sediment and pollen analysis, and by finds of *Unio pictorum* from the excavations of Ecsegfalva 23. A further channel connected to the Kiri-tó at its southern end would appear to be the original Pleistocene course of the river.

Ecsegfalva 23 appears from geophysical survey to be well over 100 m long and at least 40 m broad, but may be formed by a series of smaller clusters of occupation, whose detailed history has yet to be fully explored. It appears to be centred on a slight rise in the local topography. Trench 23B is within or close to the area of densest occupation on this slightly higher ground, but magnetic anomalies, surface finds and features demonstrated by excavation are also to be found slightly lower to the south. Trench 23C was in such a setting. Between Trenches 23B and 23C was an area potentially connecting to a local backswamp to the west. The site is also located some 350 m north of the confluence of the Kiri-tó with another relict channel.

Sites 21 and 20 to the west have yielded only Körös culture sherds in survey (Ecsedy *et al.* 1982, 79–80) *(Fig. 9.6)*. They appear to represent small clusters of magnetic anomalies (see Hamilton, chapter 9). Site 16 on the inner, northern edge of the Kiri-tó (Ecsedy *et al.* 1982, 79) appears from geophysical survey and a profile across it to be at least 50 by 20 m in extent; as noted below, it includes at least one large pit. Site 18 is on the southern, inner edge of the Kiri-tó. Both Körös and AVK sherds were recorded in the Hungarian Archaeological Topography (Ecsedy *et al.* 1982, 79), and observed during geophysical survey in 1998. Although a large area is mapped in outline by the Hungarian Archaeological Topography (Ecsedy *et al.* 1982), the geophysical survey showed the presence of only small clusters of magnetic anomalies in the area tested (see Hamilton, chapter 9), and the cluster chosen for test excavation in 1999 yielded only AVK sherds. The Körös culture presence in this location may therefore be only a slight one.

The existing record of the distribution of settlement may be incomplete in other ways. Survey to the south of Ecsegfalva 23 in 2000 (see Hofmann, chapter 9) recorded a new AVK site near the confluence with the older Pleistocene channel, while Alasdair Whittle and Michael Hamilton found another unrecorded site, Late Neolithic or Early Copper Age in date, during geophysical survey in 1998 on the inner, southern edge of the Kiri-tó, within the broader area of site 18 as mapped by the Hungarian Archaeological Topography. It was not possible within the remit of the project to extend survey further around the Kiri-tó, but that clearly emerges as an important task for the future.

Within these limitations, the initial picture is therefore of small Körös culture occupations placed at considerable intervals around the monumental natural setting of the Kiri-tó.

Locally, the survey of the Hungarian Archaeological Topography (Ecsedy *et al.* 1982, map 1) also shows some other sites, though in smaller numbers, up and down the present course of the Hortobágy-Berettyó river; a few are to be found to the north of Ecsegfalva village, on the sides of pronounced channels, presumably belonging to former courses of the Hortobágy-Berettyó river. There is also a scatter of other locations which have yielded Körös culture sherds to the east and north on alluvial islands towards the substantial area of the Nagy-Sárrét, modelled in general terms as a large, shallow backswamp in the Holocene, though perhaps in parts less wet in the mid-Holocene (Sherratt 1983a, 19); beyond the Nagy-Sárrét, Körös culture settlement did not extend *(Figs 1.1–2)*. Our knowledge of what lay locally on the other side of the Hortobágy-Berettyó river is hampered by the fact that this lies in the next county (Jász-Nagykun-Szolnok), which has not yet been covered by the Hungarian Archaeological Topography. The general picture, however, is that Körös culture occupations are not to be found north of a line passing roughly east-west from Ecsegfalva to Törökszentmiklós and the Tisza valley around Szolnok, where recent and earlier excavations have amply confirmed a Körös presence (Róbert Kertész, *pers. comm.*; Selmeczi 1969; Raczky 1982; 1983a).

The wider context: other Körös culture settlement locations

It is immediately apparent that this is a rather different situation to that described by Andrew Sherratt for the Szeghalom survey, only a few kilometres to the south towards Dévaványa, where Körös occupations concentrate along the edges of large alluvial islands above the floodplain of the Dévaványa delta (also formed in Pleistocene times: Sherratt 1982a; and see Ecsedy *et al.*

1982). Some of these concentrations extend for considerably greater distances than in the occupations so far known around the Kiri-tó and to the north of Ecsegfalva, though how far they are the result of shifting and successive occupations remains to be established in detail (cf. Sherratt 1983b).

Further south, right in the middle of what Sherratt variously calls the Körös Depression and the Körös Lowland (1982a, fig. 5; 1983a, fig. 4; Jankovich *et al.* 1989) there are many further sites on a series of alluvial islands, smaller and larger, but generally seeming much smaller than those in the Dévaványa area. The many sites in the Endrőd part of Gyomaendrőd belong to one such cluster, south of the Hármas-Körös; Endrőd 119 (Makkay 1992) is just one small site among many here, in what may have been an intricate system of creeks and backswamps. These were presumably connected to the Hármas-Körös. If that flowed in or near its present course, there would have again been very few sites actually close to the active river, though the data of the Hungarian Archaeological Topography suggest the presence of at least some. Another similar cluster at the Gyoma end of Gyomaendrőd is to be found on the north side of the Körös not far away *(Fig. 1.3)*. It is not entirely clear from the survey data so far whether this grouping is completely separate from the scatter of sites to the north, on the southern edge of the Dévaványa floodplain. West-southwest of Gyomaendrőd, and this time with an apparently more convincing gap in the distribution, the next significant cluster of sites, only some 15 km distant, is around Szarvas (Jankovich *et al.* 1989). Again a few sites may be associated with the course of the active river: here the Holt-Körös. A few may be placed in creek systems leading to or connected with the Holt-Körös, though such locations may be slightly more typical of small AVK occupations. The most striking string of sites, however, lies around the bend of a very substantial old meander of the Körös, just east of modern Szarvas. This seems again to have been of Pleistocene age (Pál Sümegi, *pers. comm.*), and was probably still water in the Holocene. It is over 300 m broad, and would have provided essentially lakeside conditions for occupation, reminiscent of the situation at Ecsegfalva though on a far larger scale and apparently far more densely occupied. A smaller old meander west of the Holt-Körös at Furugy (Pál Sümegi, *pers. comm.*) has only two recorded Körös culture occupations.

Further afield, Körös culture occupations have been found in the Tisza valley and in the Maros valley and its confluence with the Tisza. Less detailed information is available on settings. Neither around Szolnok, for example at Szajol, Szanda or Törökszentmiklós, nor in the general region of Szeged, for example at Maroslele or Hódmezővásárhely, do sites seem to be in the main river valley, but rather again in old meanders and creek systems connected to it (Kosse 1979; Trogmayer 1968a; Raczky 1983a). In the Tiszazug confluence area of the Tisza and Körös, the situation seems to be the same (Kalicz 1957; Kosse 1979, fig. 13), and this may extend also, by way of preliminary comparison and generalisation, to Serbian Starčevo or Starčevo-Körös culture sites in the northern part of Vojvodina (Dušan Borić, *pers. comm.*; Babović 1992, for the Tisza river system around the town of Becej; Girić 1975, for the north Banat around Kikinda; Sekereš 1975, for north-eastern Bačka around Subotica; and Lekovic and Padrov 1992, for the Srem region between the Sava and the Danube).

This does not necessarily exhaust the range of variation in the settlement system of the Körös culture (nor of the Starčevo culture: Dušan Borić, *pers. comm.*). Some occupations are known a little further east than those so far described, around what appear to be old courses of the Holt-Sebes-Körös, and around the western and southern fringes of the Kis-Sárrét, another potentially substantial backswamp area at this time (Ecsedy *et al.* 1982; Sherratt 1983a, fig. 4); the northern limits of the Kis-Sárrét are outside the limits of survey so far. The uppermost part of the Holt-Sebes-Körös surveyed so, as far as Körösújfalu and the Romanian border, has very few Körös occupations, though it does show Early Copper Age occupations and Copper Age mounds. It is possible that there are again gaps between clusters of occupations, but the total picture across the

Hungary–Romania border including Criş culture occupations, such as Foeni-Sălaş just over the Serbian-Romanian in the Romanian Banat, south-west of Timişoara (Greenfield and Draşovean 1994), is frustratingly unclear.

The same variation is not necessarily to be seen in all areas, but the discussion so far has suggested the recurrence of three main settings: Pleistocene alluvial deltas, which remained an important topographical feature in the Holocene and were part of the Holocene water system; active Holocene river channels, with related creek systems and small tributaries; and old Pleistocene river channels which converted to stillwater meanders in the Holocene. The former seem not so prominent in the Tisza and Maros valleys, but in the Körös basin itself, all three main suggested locations recur frequently, and often in close proximity. The fringes of substantial backswamps may also have been significant. The possible implications of this variation are discussed further below, in chapter 32.

These working suggestions take the available survey data at face value. New (though limited) discoveries around the Kiri-tó have already been noted above. Other extensive recent surface survey in the Upper Tisza project, well beyond the limits of the Körös culture distribution, has found more sites off the edges of islands and bluffs, including in the floodplain itself (John Chapman, *pers. comm.*). The Szeghalom survey also found indications in the Dévaványa area of at least some floodplain occupation by the Körös culture (Sherratt 1983a, 19). While the programme of the Hungarian Archaeological Topography has therefore yet to be subjected to critical review, the pattern it offers of Körös culture settlement seems broadly correct; later sites can be found in differing locations (Kosse 1979, *passim*), indicating that survey was not directed only at one part of the landscape. This can be reinforced by the local knowledge of surface finds and site locations, for example around Gyomaendrőd (Makkay 1992, 121–2).

The Ecsegfalva location

As emphasised in chapter 1, the choice of Ecsegfalva 23 for sample excavation was determined in the first place by the availability of appropriate pollen-bearing sediments in the immediately adjacent Kiri-tó. It is clearly not the case that Körös culture occupations were quite as uniform as often presented, and it remains to be seen from the analyses presented below whether the occupation at Ecsegfalva 23, in the distinctive setting so far described, was just like any other Körös culture site, in terms of the history, size, duration, seasonality, intensity, and character of occupation. This question is returned to throughout this volume.

Chapter 3

THE ECSEGFALVA LANDSCAPE: AFFORDANCE AND INHABITATION

Mark Gillings

Foreword

The aims of the Ecsegfalva GIS programme were essentially twofold. At the broader regional scale, GIS techniques were utilised in an attempt to characterise the contemporary landscape of Ecsegfalva 23 and explore the sites place within it. At the more immediate scale, GIS provided the analytical and management framework within which the results of the programmes of excavation, geophysical survey, surface collection and topographic survey could be integrated and interpreted. It is the former that will be discussed in detail here. After a brief introduction outlining the ways in which GIS has been applied within landscape archaeology, GIS techniques are employed to facilitate an investigation into the nature of the Early Neolithic landscape of the Kiri-tó meander. This is followed by the application of new methodologies that seek to provide pathways into the characterisation of the lived landscape of the site, its rhythms, qualities and textures. The discussion will close with an evaluation of the methodologies used and a brief summary of the key conclusions drawn.

Introduction: GIS and the analysis of sites in their landscape setting

Within landscape based studies in general, and GIS-based studies in particular, there has been a distinct methodological bias towards explaining *why* sites are found in their given locations (working from the outside in), as opposed to attempting to describe what it may have been like to inhabit and *live* in these locations (working from the inside out). This is despite over a decade of important and stimulating research in both archaeology and anthropology that has stressed the unique and challenging insights such a change in focus can bring. This emphasis upon the question *why* has resulted in a resurgence of interest in formal spatial analysis and locational modelling and lies at the heart of arguably the most commonly applied GIS approach of all: Predictive Modelling (e.g. Westcott and Brandon 2000). The latter is predicated upon the assumption that a series of key environmental determinants for site location can be distilled out of a given landscape context and then used to predict the locations of similar settlements in unsurveyed areas and/or explain past settlement decisions (for critical reviews see Ebert 2000; Wheatley 2004). When interest has focused down to the level of the individual site, rather than attempt to investigate and explore the mundane and prosaic aspects of everyday life, studies have tended to be dominated and driven instead by very specific concerns linked to meta-questions of economy and ecological adaptation. This is perhaps most evident in the resurgence of interest amongst archaeologists employing GIS in techniques such as Site Catchment Analysis (e.g. Hunt 1992; Dann and Yerkes 1994; Saile 1997) that seek to characterise a given site location through an assessment of the resource area that could be 'profitably' exploited from it (Higgs 1975, 223).

In the rare cases where GIS-based studies have attempted to embrace developments in contemporary theory, these have tended to focus upon one particular analytical function nestling within the GIS toolbox. This involves the delineation of the simple visual properties of a site location through the calculation of a viewshed (i.e. a map of what can, and cannot, be seen). These have been used to characterise and explore specific aspects of site location such as social prominence and defensibility (e.g. Mitcham 2002); visual interaction and relationships between locations (Trick 2003); and even to quantify the symbolic 'value' of sites within perceived ritual landscapes (e.g. Gaffney *et al.* 1995).

Whilst the present application of GIS certainly seeks to explore the question *why,* this is only one aspect of the research. From the outset a key concern has been to fashion a different kind of GIS-based landscape archaeology. This is one that seeks to move beyond locational modelling and the methodological impasse offered by simple viewshed calculations to more fully integrate developments in current landscape theory. This firstly entails moving away from such staple questions as: '*why is the site there (and not in any of the other places it might have been)?*', '*what can be seen from it?*' and '*would the location have provided convenient access to water and sufficient land to sustain permanent agriculture?*'. Instead the focus of attention shifts to consider the question, '*what may it have been like to live out a life at the site, embedded within its everyday rhythms and those of the world around it?*'. In essence, the challenge is one of replacing a traditional spatial archaeology with what might be termed a 'platial' one. In such a formulation functional or economic descriptions of locational criteria take second place to more chorographic examinations of the grounded experience of everyday life and dwelling. Whilst the current report does not claim to offer a fully fleshed set of conceptual and practical methodologies, it is hoped that it will act as a stimulus for further sustained research on this topic.

The Körös landscape

The starting point for the study of the landscape of Ecsegfalva 23 was a tacit acceptance that the landscape we see, encounter and experience today may be very different from that of the sixth millennium cal BC. As a result, the first stage in the GIS study was to evoke as closely as possible the contemporary landscape of the site occupation(s). As the geomorphological work carried out by the project has shown (chapters 4–5), in the Early Neolithic the landscape of the site was (as it still is) characterised by an essentially flat, gently undulating terrain, criss-crossed by a complex pattern of relic channels, lakes, backswamps and oxbows; a landscape dominated by water.

It was also deeply unstable and dynamic. In the Early Neolithic, as today, the study area was subject to annual flooding. Indeed over 50 per cent of the territory of modern Hungary is prone to flooding, with the Upper Tisza catchment carrying the highest risk of inundation (Vari *et al.* 2003, 586). Flood events on the Tisza are cyclical comprising: predictable annual spring events (the so-called green floods); less frequent February floods caused by ice-melt; and secondary summer floods corresponding to the precipitation maxima (Sümegi *et al.*, chapter 5). Punctuating these cycles were largely unpredictable extreme floods that could have a catastrophic effect on the surrounding landscape (Gillings 1997, 165). The typical interval between these rapid, potentially devastating wildcard floods is, in prehistory, unknown. However, detailed records taken from the nineteenth century onwards suggest a frequency of one extreme flood every 18 or so years in the early twentieth century, becoming annual since 1998 (Vari *et al.* 2003, 586). To give an idea of the impact of such an event, despite a considerable programme of control works initiated in the mid nineteenth century, and approximately 3000 km of levees bordering the Tisza, the flood of March–April 2001 resulted in the destruction of 1000 houses, with damage to a further 2000, and the evacuation of 17,000 people as flood waters rose at a rate of 10.5 m in a period of just 52 hours (Fenyo 2001, 8; Vari *et al.* 2003).

Returning to the relationship between contemporary and palaeoenvironments, whilst the landscape is still flat, and still floods, it is important to acknowledge that significant differences occur with respect to the impact and dynamics of these events. As a result, despite sharing some characteristics, the modern landscape cannot be taken uncritically as a direct analogue for that of the Körös culture (cf. Gillings 1995; 1997). As the extensive coring programme undertaken by Pál Sümegi has shown (chapter 5), though today largely drained and cultivated, during significant phases in the Holocene the relic channel of the Kiri-tó held substantial volumes of standing water. In addition, the impact of the nineteenth century flood controls upon the Berettyó was dramatic, reducing the overall length of the river channel from 252.5 km to a mere 90.9 km. This has not only contributed to the regular network of levees and drainage canals that currently partition the landscape but has greatly altered the dynamics and impact of flood waters as they enter the regulated system today.

As for the question of pre-control flood impact, the detailed coring program undertaken across the site and Kiri-tó has identified two distinct layers that appear to mark seasonal maxima and minima in the groundwater table, corresponding to elevations of 81 and 84 masl respectively. With respect to the dynamics of this event, rather than episodes of overbank flow, with flood water surging in to the relic channel, water levels appear to have risen largely through infiltration and the steady rise of the water table. Rather than part of a largely homogenous flood-zone, this would suggest more of a patchwork, with the Kiri-tó and other relic channels forming isolated lakes during the flood season, their levels rising and falling in response to changes in the groundwater.

Looking to the vegetation, rather than any continuous forest cover pollen evidence has suggested a mosaic environment, with patchy clumps of Oak and Hazel on the highest ground along with dense beds of reeds concentrated in the relic channels, lake beds and backswamp locations. Looking to the site itself, einkorn, emmer and barley were being cultivated by the Ecsegfalva 23 community in what appear to be fixed, intensively managed garden plots (Bogaard *et al.*, chapter 23).

Approaching the Early Neolithic landscape of the Kiri-tó meander

The first stage in the process of generating a digital surrogate of the Early Neolithic landscape was to create a continuous representation of the surface topography of the study area that would act as a foundation layer for all subsequent analyses. This was through the generation of a Digital Elevation Model, or DEM (Wheatley and Gillings 2002, 107–23). Contours at a vertical resolution of 0.5 m were digitised from a block of 4 × 4 1:10,000 scale base-maps, covering an area of 24 by 16 km centred upon the Kiri-tó meander. In digitising these contours care was taken to exclude those relating to modern drainage features and artificial levees, otherwise the topography follows the modern record and this should be borne in mind throughout subsequent analyses. Although in some circumstances the modern topography can appear to offer a reasonably robust surrogate this cannot always be assumed, particularly in a landscape where there are known areas of made ground and redeposited material from the digging of the drainage channels (Pál Sümegi, *pers. comm.*) not to mention having been subject to over seven millennia of flooding.

The resultant contour layer was then interpolated to yield a DEM at a ground resolution of 20 m (the *study region* DEM: *Fig. 3.1*). This was to provide the primary analytical layer for the hydrological simulations described in detail below.

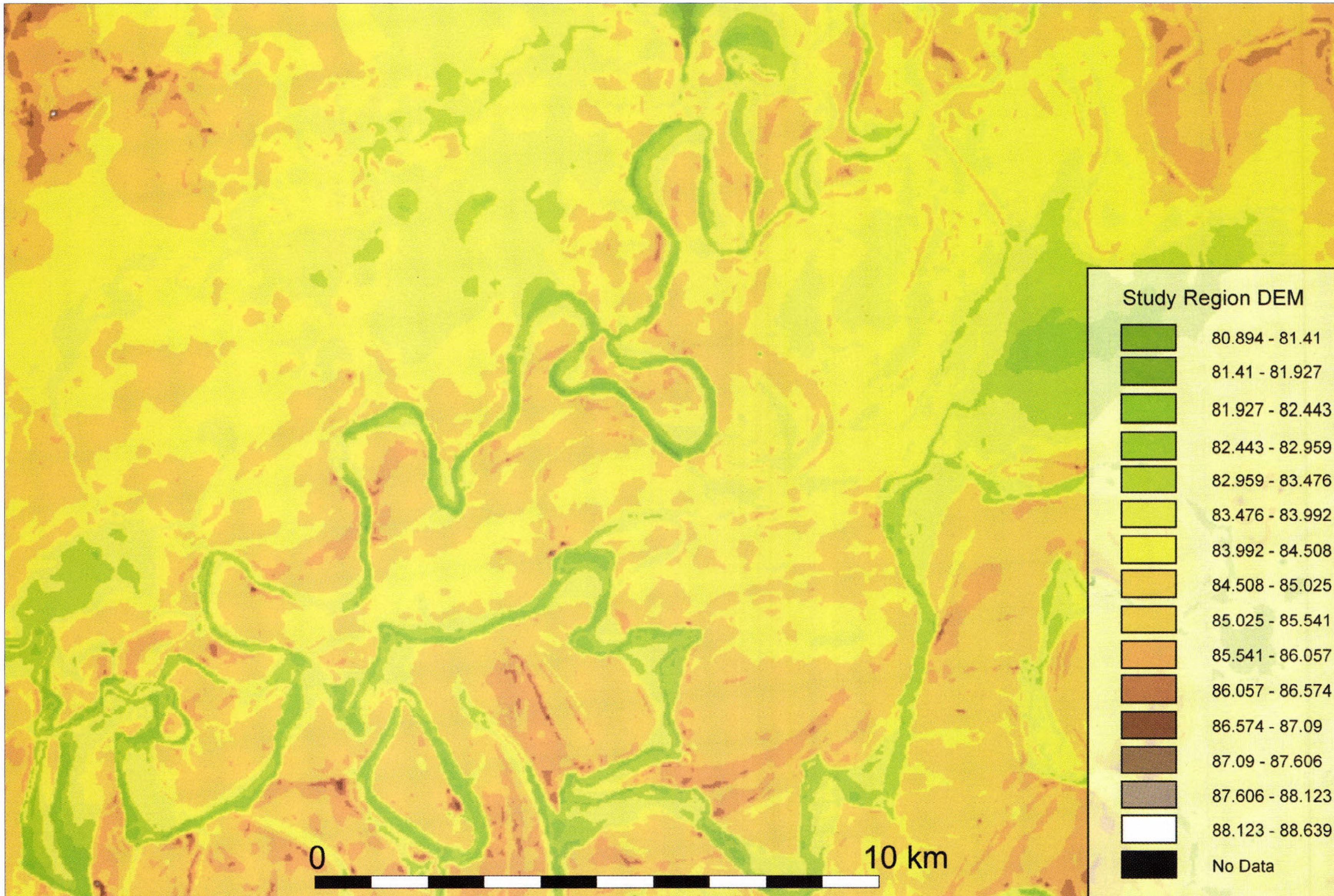


Fig. 3.1. The study region DEM (20 m resolution)

As the analysis progressed it rapidly became clear that to facilitate a more nuanced chorographic study of Ecsegfalva 23, a higher resolution and more focused elevation model was required. To this end a second DEM was generated focussing on the central 12 by 8 km portion of the overall study area (2 × 2 1:10,000 mapsheets). Here the contour information was further enhanced through the digitising of individually mapped spot-heights taken from the 1:10,000 base-maps. This second DEM (*site environs*) was created with a ground resolution of 10 m *(Fig. 3.2)*. The final elements to be digitised comprised the location of the Ecsegfalva 23 site along with the locations of other Körös culture sites recorded in the 'Magyarország Régészeti Topográfiája' (Hungarian Archaeological Topography) for County Békés.

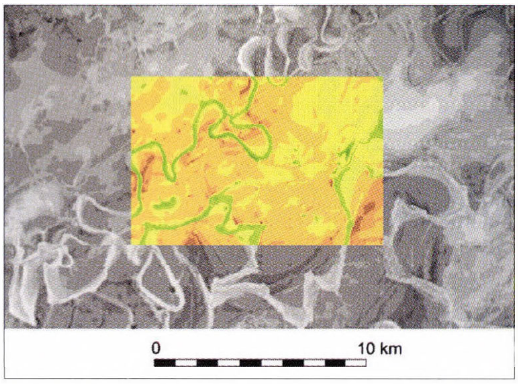


Fig. 3.2. The site environs DEM (10 m resolution)

With the DEM in place attempts could be made to assess the role played by floods and floodwaters in the structuring and organisation of the surrounding landscape. The procedures for extracting hydrological information from a DEM have been discussed in detail elsewhere and will not be repeated here (Gillings 1995; 1997). In essence, from each grid cell location (i.e. 20 × 20 m block) in the DEM, the GIS traces and records the downslope drainage direction and accumulation of hypothetical water drops. By combining this information across the DEM natural drainage channels can be extracted, drainage basins delineated and sinks identified (i.e. natural sump features within the topography that were being actively drained into). The hydrological analyses were structured around three key questions. The first was to delineate the drainage sub-basins present in the study area principally to facilitate more contextual and critical analysis of the pollen cores taken from the site environs and Kiri-tó. The second was to identify natural lakes and ponds (sinks) within the topography that as a result of drainage patterns may have held standing water for much of the year, along with natural ridges and areas of high-ground that would have been least prone to the effects of inundation. The final aim was to explore the impact of the groundwater thresholds identified in the coring programme upon the overall shape and texture of the landscape.

As an adjunct to the hydrological analyses, a terrain feature extraction was undertaken on the DEM, looking to highlight ridges and valleys. As such features are profoundly scale-dependent and inherently fuzzy, a multi-scale approach was adopted (Wood 1996). The extracted drainage sub-basins for the study area are shown in *Fig. 3.3* along with the natural ridges.

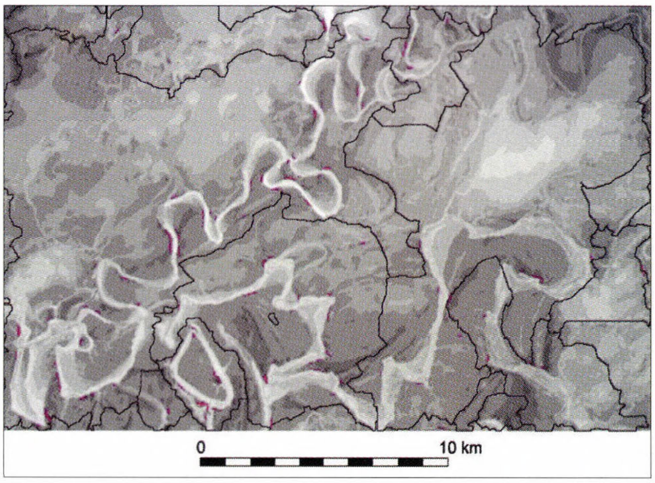


Fig. 3.3. Drainage sub-basins (black) and natural ridges (red)

What is immediately clear is that the site, and more importantly the Kiri-tó, fall within a single well defined drainage catchment. Looking to the ridge locations, rather than a clear and distinct network, the subtle terrain of the study area results in a much more discontinuous picture with pockets of high ground that appear to follow closely the relic channel banks and natural levees. With respect to the sinks and natural valleys present

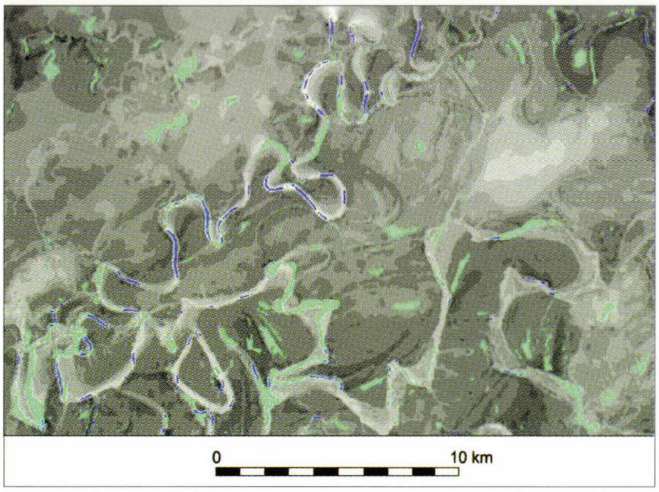


Fig. 3.4. Sinks (light blue) and natural valleys (dark blue) present in the study area

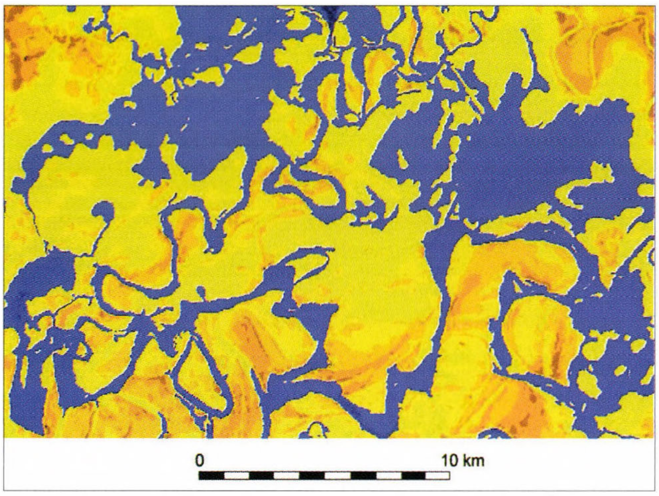


Fig. 3.5. Inundating the landscape to the 84 masl threshold

within the DEM, these are more extensive and, perhaps not surprisingly, correspond largely to the courses of the relic channels *(Fig. 3.4)*.

To simulate the impact of an annual flood the distinctive 81 and 84 m bands identified in the program of coring were utilised to set inundation thresholds. A simple reclassification was then undertaken to highlight this inundation band *(Fig. 3.5)*. It is important to emphasise that this is not a formal model or simulation of a flood event, nor does it embody the dynamics of the flooding and subsequent draining processes. Its role is more to act as a point of departure in considering the likely impact of an annual flood on the study area landscape in the sixth millennium cal BC.

The final stage in the creation of the spatial database was to facilitate the integration of the dominant vegetation (trees and reeds) into the DEM, adding texture and variation to the otherwise smooth surface. The process of reconstructing past vegetation cover in the GIS is fraught with difficulties arising largely from the paradox that while we often know in considerable detail *what* species were present in a given area, we have little idea as to *where* exactly they were growing beyond general species preferences derived from modern analogues. Given the dramatic effects changes in vegetation position can have upon analyses of, for example, visibility (see below) the problem is a pertinent one. In the present study the approach has paralleled that taken with the inundation thresholds. The simulation is not intended (or argued) to be a definitive or formal model of Early Neolithic vegetation patterns. Instead it is intended to generate an awareness and critical appreciation of the presence and impact of vegetation cover upon the analyses attempted.

The first task was to simulate the locations of the stands of oak and hazel present in the landscape (Willis, chapter 6). Here the extracted ridges, corresponding to isolated areas of the driest ground present in the study area, were treated as surrogates. Looking to modern species, the height estimates for mature Hungarian oak trees fall between 24 and 30 m, with non-shrubby hazel in the range 10 to 24 m. From this overall range of 10–30 m a 'typical' tree-height of 20 m was taken that could be added to the ground elevations upon the ridges to simulate the patchy stands of woodland.

With regard to the reed-beds, the decision was to place reeds in all of the waterlogged or readily floodable areas (i.e. land below 84 m) effectively choking these areas with continuous reed beds. A reed stand height of 2 m was adopted based upon the typical reed height encountered today in the surviving reed beds present in the Kiri-tó channel.

On the basis of these estimates, second versions of the *study region* and *site environs* DEMs were generated that incorporated tree and reed heights into their surface elevation values.

The site in the landscape

If we introduce the known distribution of Körös sites we immediately see stark confirmation of the long recognised affinity between sites and water, with the majority of sites (though interestingly not all) located directly adjacent to the relic river channels and major zones of flood inundation *(Fig. 3.6)*.

Although the sample of sites is too small to investigate any significant patterning with respect to the basin edges and natural ridges in any formal statistical way, it is interesting that in the immediate vicinity of the Kiri-tó meander sites also tend to favour natural ridge locations. Indeed the site of Ecsegfalva 23 itself sits directly upon one of the extracted ridges. This relationship is even clearer when we consider the higher resolution *site environs* dataset *(Fig. 3.7)*.

Whether this latter trend is a reflection of deliberate and conscious decision-making, or the by-product of a general preference for channel bank locations coupled with a tendency for ridges to coincide with natural levees is open to discussion, but we are still left with a marked distributional pattern that needs to be explained.

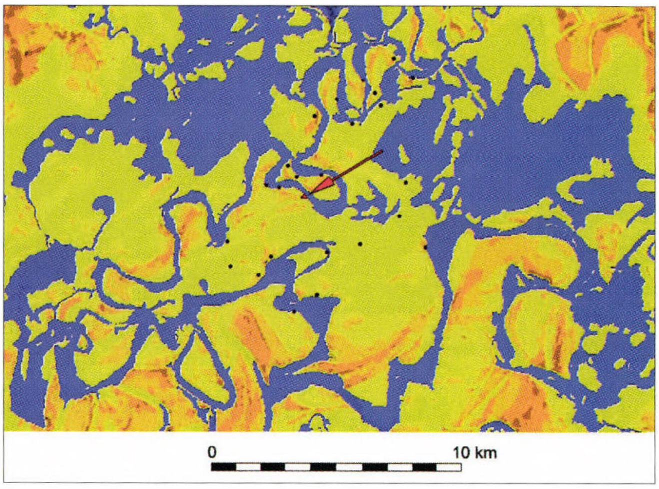


Fig. 3.6. The Körös culture sites (Ecsegfalva 23 = triangle)

Given the dynamics of the floodplain environment it is tempting to read such distributions in terms of a subtle balance between economic exploitation and risk management. The sites are located so as to maximise the economic resources provided by the lakes, oxbows and fertile floodplain soils, yet are insulated from the harmful and damaging effects of any floods by exploitation of the highest areas of available ground. Life in the floodplain is thus one of constant tension and negotiation. However, although issues of risk management and damage limitation dominate contemporary debates concerning flooding in general, and floods in northeast Hungary in particular (e.g. Vari *et al.* 2003), I would suggest that in the context of the Körös settlements such a perspective may be at best limiting. To understand the landscape of Ecsegfalva 23 we must try to approach our understanding of life in the floodplain from a perspective other than that of risk. This is not to downplay the destructive capabilities of the floods or deny their catastrophic impact, but to argue that concerns with risk and damage limitation may reflect a particularly modern way of thinking about the relationship between people (culture) and the environment (nature) they inhabit that may have made little sense to those dwelling in this landscape in the sixth millennium cal BC (Gillings 1998). Instead of regarding floods solely in terms of impact, we might consider them instead as an *affordance* of the floodplain in much the same way as the fertile soils and flora and fauna that frequented the oxbows and backswamps, replacing an oppositional framework of risk and opportunity with one of synergy and embeddedness. In this sense it is interesting to note that in the medieval period, despite an estimated four devastating floods per century, it has been claimed that these events

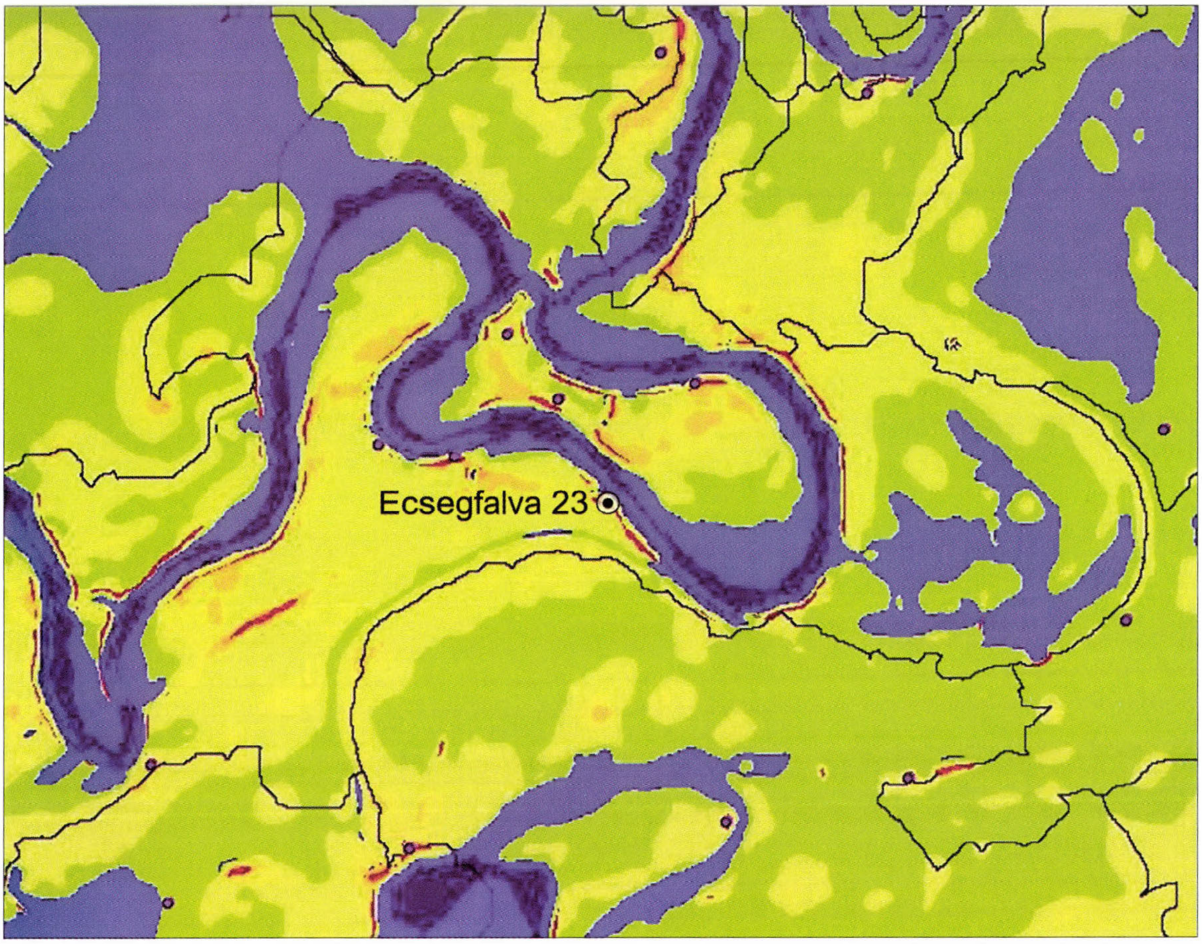


Fig. 3.7. Detail of the Kiri-tó meander and Ecsegfalva 23

were not regarded as posing risks or threats but were considered part of everyday life in the plain, with settlement strategies adapted to the effective farming of the floodplains (Hankó 2000).

Affordances

The term *affordance* is used deliberately here and at this point in the discussion it is important to define exactly what is meant by it. The concept of affordance was introduced into landscape archaeology by the anthropologist Tim Ingold, himself drawing upon the work of the psychologist James Jerome Gibson. Affordances, as defined by Ingold, are what a given environment offers an agent in the context of their practical action (Ingold 1992; 2000) and comprise a concerted attempt to bypass oppositional frameworks for the study of human-landscape relations predicated upon a rigid culture:nature duality. Previous attempts have been made to develop an affordance-based approach to the study of archaeological landscapes (e.g. Llobera 1996), predicated upon an attempt to effectively map the affordances of given landscape configurations. For example, what does a particular landscape configuration afford someone engaged in an attempt to hide or find a prominent viewpoint? This work has, however, attracted criticism on the grounds that according to other readings of the term, affordances can never be regarded as tangible properties of objects in the environment that can be isolated and mapped. Instead they must be treated solely as *apprehensions* of possible actions (Webster 1999). This criticism may not be entirely fair as the question as to whether affordances can exist independently of a given agent as opposed to being bestowed upon an object or landscape configuration by an agent in the act of perceiving, is one that has prompted considerable debate (see, for example, the discussions in Thompson 1995 and Ingold 2000). As a number of commentators have noted, even Gibson himself was far from clear on the subject.

I would argue that a profitable way forward for archaeological studies can be found in the arguments presented by Evan Thompson, himself building upon the work of Ben-Ze'ev. Here it is suggested that affordances should be considered as dispositional properties, where the specific manifestation of the disposition depends upon the specific requirements of the individual animal engaged in a given action. Following this argument, affordances can be thought of as either *actual* (realised) or *potential* (for all intents and purposes latent). This is not to argue that affordances occupy clearly defined states. To give an example, for much of the year the floodplain potentially affords inundation, whilst at the same time actually affording expectation and anticipation of the coming waters to those dwelling within it, the relation between the two mediated by experience, memory and apprehension. In addition, active agents may, or may not, perceive the potential affordances offered by a particular landscape configuration, this is not to say they are not there (Thompson 1995, 228–9). It is this reading of the term affordances that I will be advocating here.

The values of this perspective are twofold. Firstly a focus upon the concept of affordance offers a way of overcoming the hegemony of stark oppositions between culture and nature that underpin the majority of distributional studies. Rather than continually pitting people against environment, or *vice versa*, such a perspective stresses what Ingold has termed the 'mutualism' of person and environment relations (Ingold 1992, 40). Secondly, it encourages an explicit and active appreciation of the *inhabited* nature of the floodplain, encouraging us to think in terms of potentialities rather than a continual balancing act between finite choices. Mark Macklin and David Passmore have recently argued that flood events should be seen as providing 'a highly dynamic, and rapidly changing backcloth to the prehistoric and historical occupancy of river valleys' (Macklin *et al.* 2003, 10). Following the above, I would argue precisely the opposite. Rather than a 'backcloth', a much more profitable and rewarding way of approaching the issue is to consider human occupancy as part of the very weft and weave of the floodplain environment. Rather than merely posing a calculated risk, the annual rising and falling of the flood waters introduced a crucial temporal dynamic into the life of the floodplain, accompanying the seasonal transformations in the flora and fauna. In addition, each successive flood event served to bring something new to the environment, serving to subtly reshape and, following John Evans, *re-texture* the landscape, enriching the soil and recharging the ponds and lakes (Evans 2003, 45–72). These floods were also profoundly liminal events, predictable only insofar as it is known that they will happen, the precise impact and effects unknown from year to year. Proximity to the relic channels may therefore reflect as much a concern with actively attending to the dynamic of flooding itself as the nutrients and floundering fish left in its wake.

Visual affordances of the landscape

The essentially flat nature of the floodplain landscape affords considerable fields of view from those elevated locations within it. Looking to the site, its position on one of the few clear ridge locations should result in extensive views out across the surrounding landscape. That this is the case is confirmed in *Fig. 3.8*, where a viewshed has been delineated from the site assuming a viewer height of 1.75 m.

What is interesting about the resultant viewshed is not so much the sheer extent of what is theoretically visible from the site, but those key areas of the landscape that are, for all intents and purposes invisible. This corresponds in the main to the relic channels, lakes and oxbows that score

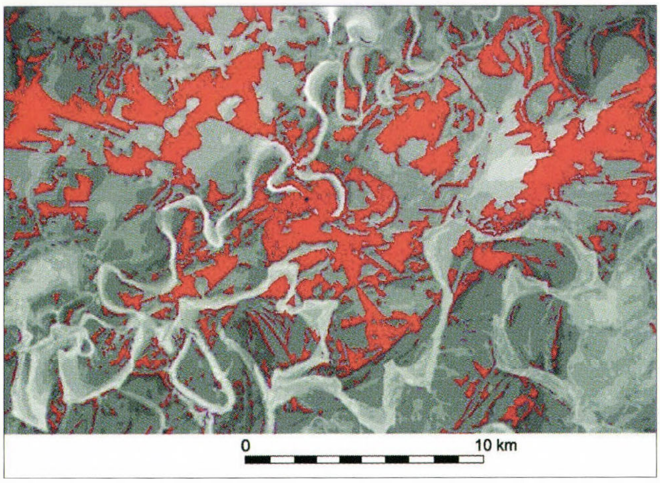


Fig. 3.8. Viewshed (red) generated from Ecsegfalva 23

Fig. 3.9. Degree to which areas are visually hidden or exposed

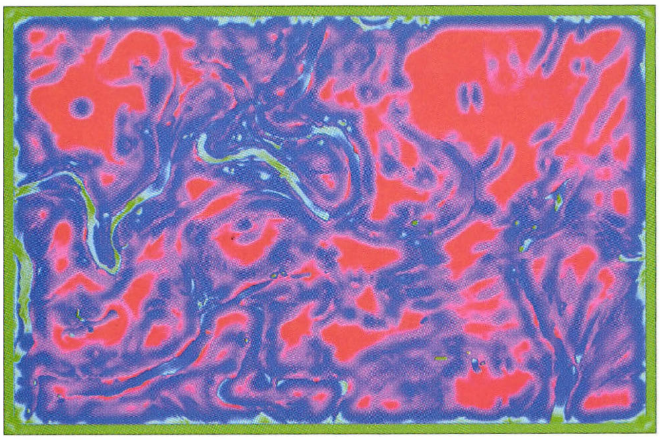


Fig. 3.10. Relative visual prominence

the landscape. To investigate this further two cumulative viewshed analyses were carried out using the r.cva routine developed by Lake for GRASS GIS (Lake *et al.* 1998). Due to the large computational overheads involved in this analysis it was restricted to a specific version of the *site environs* DEM that was generated at the same spatial resolution as the Study Region (i.e. 20 × 20 m). In each case the result is what might be termed a potential affordances map. In the first analysis each cell was encoded with a value equal to the number of cells it was visible from, effectively communicating the degree to which specific areas of the landscape were usually hidden or exposed *(Fig. 3.9).*

Although at first glance rather bewildering, the colours encode whether an area is exposed (red) or hidden (dark blue), with intermediate zones taking purple hues. It is immediately clear from *Fig. 3.9* that the most hidden zones correspond to the channels, particularly in the immediate vicinity of the Kiri-tó meander where the channel banks are most obviously 'hidden'. Within the bodies of the relic channels and oxbows the degree of exposure appears to be intermediate, indicated by a predominance of lilacs and purples. The degree to which this level of exposure reflects visibility from beyond the channels or is restricted to views within them is addressed by the second analysis.

Here each cell in the original DEM was allocated a value equal to the number of cells that could be seen from it. This effectively highlights those areas of the landscape that afford the greatest views (reds) and vice versa (blues and greens). As *Fig. 3.10* shows, whilst the majority of the landscape offers open, unrestrained views, the channels, particularly the Kiri-tó meander, are closed and restrictive.

Taken together, the results of the cumulative viewshed analysis suggest something of a paradox. On one level the landscape affords extensive views across its surface. Yet at the same time the dramatic impact on fields-of-view introduced by even the most subtle topographic features serves to hide the numerous channels that cross it, the latter pointedly out-of-view. Furthermore, visibility in and out of the channels is restricted resulting in a set of visually closed spaces. This is a landscape that is simultaneously open and exposed, yet closed and hidden.

Given the importance that has traditionally been placed upon the *spatial* proximity of Körös culture sites to watercourses, it is fascinating to note that in visual terms they are worlds apart. This has a number of significant implications for issues such as movement through the landscape, with travel along the waterways affording a rather detached, claustrophobic experience in contrast to that gained from movement across the plain itself.

So far the analysis of the visual properties of the Ecsegfalva 23 landscape has been based upon the featureless surface of the DEM, taking no account of, for example, vegetation effects. As has been noted above, in a terrain as flat as the floodplain, even minor changes in the surface topography can result in marked impacts upon the calculated viewsheds. To explore the impact of vegetation upon theoretical views from the site, the reed beds and tree stands were introduced into the analysis *(Fig. 3.11)*.

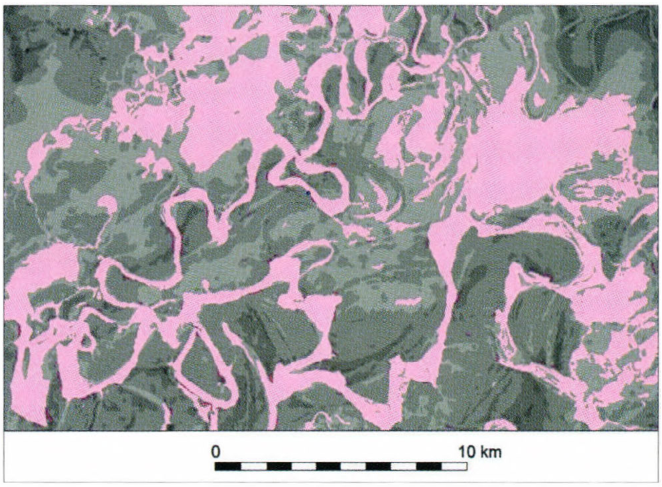


Fig. 3.11. Simulated locations of reeds (pink) and trees (red)

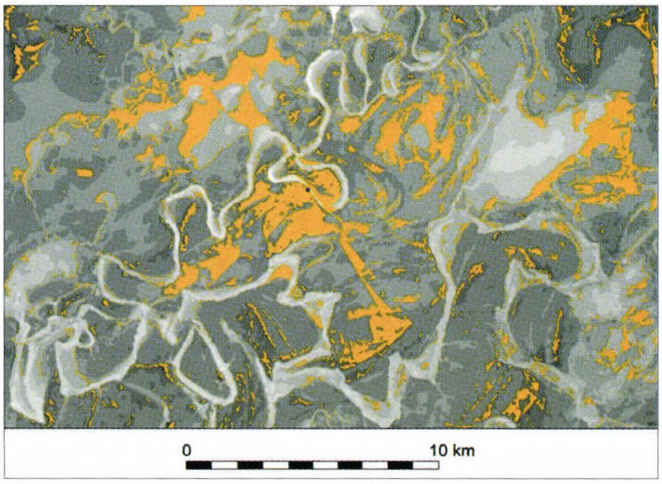


Fig. 3.12. Impact of reeds on the viewshed

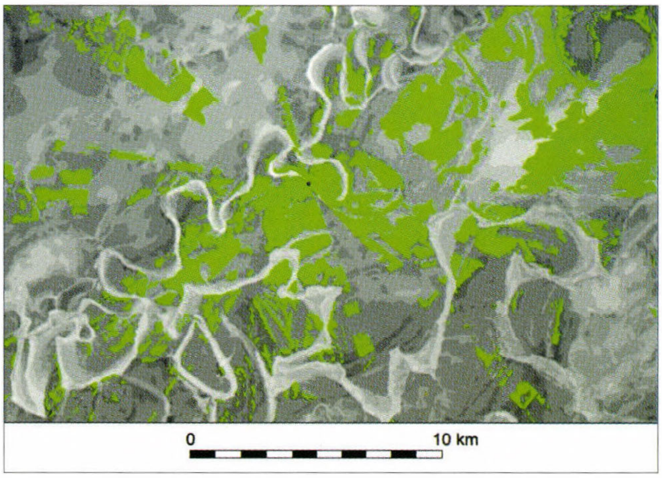


Fig. 3.13. Impact of trees on the viewshed

One immediate problem that had to be overcome concerned the coincidence of the site location with a ridge. By simply treating the isolated ridges as surrogates for stands of woodland we effectively place the site in a clump of trees, a decision that has a commensurate impact upon the viewsheds yielded. To overcome this, the site ridge was digitally 'cleared' of trees, leaving all remaining ridge clumps within the analysis. Viewsheds were then generated to investigate the progressive impact of the reeds *(Fig. 3.12)*, the trees *(Fig. 3.13)* and the combined vegetation *(Fig. 3.14)* upon the visibility patterns produced.

The addition of vegetation can only ever be an exploratory exercise, but it is clear from *Figs 3.12–14* how as vegetation is introduced on to the surface the views are slowly drawn in, the impression of a broad vista giving way to a

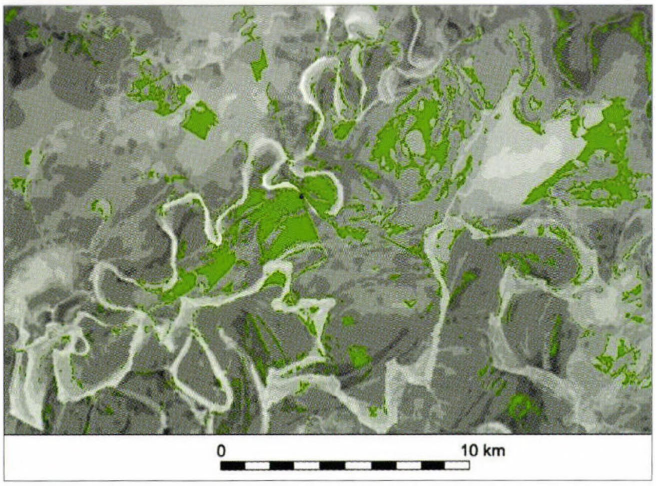


Fig. 3.14. Combined vegetation effect

much more bounded viewshed, with the channels dramatically hidden from casual sight. In effect the vegetation serves to close the visual world down. This is a general (and some may argue obvious) conclusion but still an important one with respect to an understanding of place in the Early Neolithic landscape, particularly given the extremely conservative placement of tree stands incorporated here.

The landscape in the site

So far what has been undertaken could be interpreted as a rather traditional GIS-based study of the site in its landscape, albeit one biased towards qualitative description rather than formal statistical summary. In what follows a first attempt has been made to use GIS to focus instead upon the way in which the landscape is embedded in the site, shedding light upon everyday experience of life in amongst the reed beds.

The point of departure for this study will be a particular reading of the concept of the *taskscape*. Following Ingold, this refers to the complex array of practical activities carried out by people during the course of living their everyday lives (Ingold 2000, 195). The taskscape is inherently temporal, resonating to a complex inter-twining of rhythms and cycles that 'are embodied, in the sense that they are not only historically incorporated into the enduring features of the landscape but also...inherent in the rhythmic structure of the activities themselves' (Ingold 2000, 200). It is also profoundly qualitative, something that can be described but not measured (Ingold 2000, 195).

In seeking to explore and describe the taskscape of Ecsegfalva 23 the first task has to be one of defining and mapping its limits. If we assume it to reflect the complex comings and goings of everyday practical activities centred upon the site and garden plots, where does it effectively end and how do we define its spatial footprint? This is a far from trivial task as by its very definition the taskscape is fluid and negotiable; rather than a fixed arena within which activities take place, it is an arena that gains its meaning and definition through those very activities. The approach here follows Ingold's suggestion that 'the limits of the taskscape are the limits of the auditory world' (Ingold 2000, 199), definition of the taskscape involving the establishment of a perceptual catchment area for the site.

As discussed in the introduction, archaeology has long been concerned with the inscription of catchment areas around sites, but in the past this has been driven by the principles of energy maximisation and least-cost. The current analysis attempts to reclaim the notion (and value) of spatial catchments for archaeological interpretation by foregrounding perception rather than modern capitalist economics in the delineation of such areas. How then does one go about defining a perceptual catchment? In the past visibility has been seen by some researchers as synonymous with perception, leading to some rather grand claims for the relatively straightforward GIS-analytical procedure of viewshed analysis (e.g. Gaffney *et al.* 1995, 222; cf. Gillings and Goodrick 1996). By equating perception solely with visibility (and what is more, an understanding of visibility that translates it into the mapping of a rather abrupt series of zones which are either unambiguously in or out of view), such an assumption fails to acknowledge or appreciate the subtlety and complexity of the act. Instead it could be argued that rather than merely looking, perception is much more nuanced, at the very least engaging the full range of senses and predicated upon a mobile, active body. The key challenge becomes one of how we meaningfully integrate this richer conceptualisation into our GIS analyses.

One obvious (and perhaps tempting) answer would lie with the 'cook-book' approach that is embedded in the underlying conceptual frameworks of GIS and characterises much contemporary GIS analysis. This would involve the generation of a series of aseptic viewsheds, smellsheds and soundsheds that could be mixed and blended together using the analytical capabilities of the technology. Putting aside the sheer complexity of delineating such innocuous sounding products as 'soundscapes', such an approach would fail to capture the sheer fluidity and dynamism of the sensual world. For example, the way in which sounds, smells and sights come in and out of being with the events that give rise to them, sensitive to the attentiveness of the perceiver and subtle changes in the direction of the wind and clamour in the background. Any claimed 'map' would at best offer a partial, selective snapshot and at worst a fiction. Instead it will be argued here that a potential solution can be offered by taking a step back, seeking not to characterise the individual components of the range of senses but instead to establish the total limits or boundaries of multi-sensory perception, that is, the point beyond which we can only engage with the world through movement or our eyes.

To establish the extent of this catchment, inspiration was taken from the pioneering work of Higuchi and his studies of the visual and spatial structure of landscapes. To Higuchi a view could be divided into 3 components: the *short-distance* view (foreground); the *middle-distance* view (middle ground) and the *long-distance* view (background) based upon changes in the horizontal angle of gaze. The boundaries of each of these components were calibrated using a standard multiplier and the dominant tree-height for the landscape in question. Despite its predominantly visual focus, what is of particular interest here is Higuchi's *short-distance* band, where objects and features are perceived as being immediate and close to the viewer, engaging *all* of their senses. In quantitative terms this corresponds to a radius of approximately 60 times the size of the dominant tree species for the area (for a detailed discussion in a GIS context see Wheatley and Gillings 2000).

In practical terms the short-distance Higuchi threshold offers us an effective boundary that is based upon the engagement of all of the senses, not merely vision. A boundary that can be used to inscribe a perceptual catchment around a given point. As discussed earlier, tree heights in the landscape would fall between 10 and 30 m with an average 20 m taken for the purposes of viewshed generation. If we treat this as our dominant tree-height and apply the respective Higuchi multiplier ($\times$ 60) this results in a simple binary catchment circle 1200 m in radius centred upon the site *(Fig. 3.15)*.

As it stands this catchment zone offers a rather stark distinction between what is perceived and what is not. In so doing it fails to take into account the fact that our senses tend to degrade

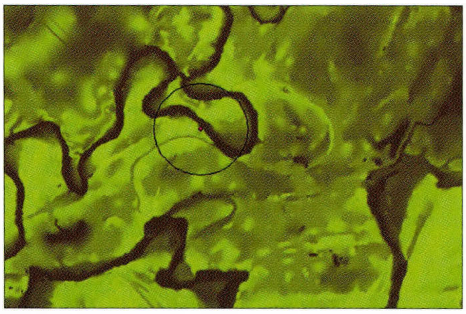


Fig. 3.15. Simple binary 'perceptual catchment'

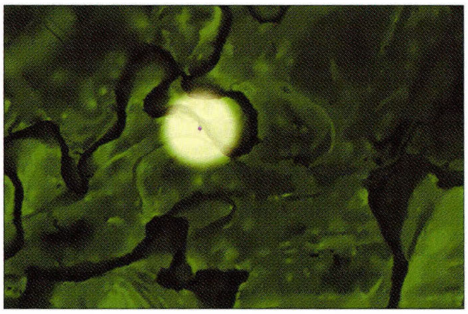


Fig. 3.16. Introducing fuzziness and ambiguity at the periphery

Fig. 3.17. The visual portion of the catchment

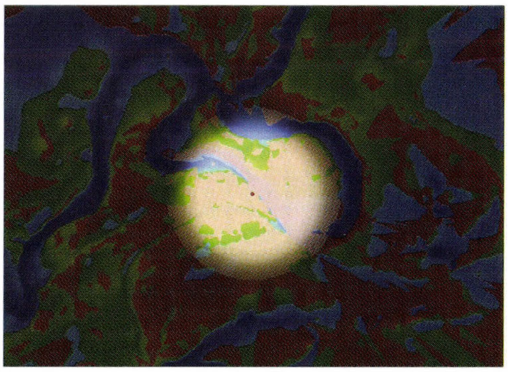


Fig. 3.18. Enriching the perceptual catchment

with distance rather than simply stop; that is, there is a fall off in perceptual clarity the further we get from the perceiver. In an attempt to accommodate this gradual fall-off, an intermediate height of 15 m was taken to mark the point at which perceptual clarity begins to fall away. It is important to emphasise that this value is largely arbitrary, approximating the height of a typical hazel tree. A fuzzy reclassification procedure was then employed to simulate a gradual fall off with distance, highlighting a zone of increasing ambiguity at the edges of the catchment. The resultant zone is shown in *Fig. 3.16.*

The result is an initial attempt to map the perceptual catchment of Ecsegfalva 23. Although a simplification with respect to the taskscape of the site insofar as it is essentially fixed and static, it is hoped that it will provide a useful point of departure in attempting to qualitatively assess what it was like to dwell at Ecsegfalva 23. As importantly it can also be read reciprocally, reflecting as much those areas of the landscape where the site feels perceptually intimate and 'close', perhaps those areas of the landscape where people felt most 'at home'.

If we combine the perceptual catchment with the site viewshed we can further enhance the interpretative potential of the catchment as it is now possible to draw attention to those areas of the taskscape that were perceptually intimate yet largely out-of-sight, audible presences rather than visual ones. *Fig. 3.17* shows the optimum viewshed from the site (i.e. not including vegetation effects) with the area falling within the perceptual catchment highlighted.

This can then be integrated into the perceptual catchment along with the simulated flood waters to facilitate a much more enriched description of place *(Fig. 3.18).*

Describing the taskscape

The first key observation concerns the relationship between the site location and the oxbows, lakes and relic and active channels. Thick with reeds these would have been at the very edge of vision, yet strongly presenced through the rustles and whispering of the reed beds. With the exception of the segment of channel directly to the southeast, these were areas that could not be gazed upon but had to be visited. Upon encountering the reeds this sense of liminality would be further enforced through the nature of the beds themselves. There is a tendency to discuss the reed beds as a single undifferentiated entity, but it is important to acknowledge that they have a very distinctive spatial structure, different areas of a given reed bed affording very different characteristics. For example, research by András Báldi has shown that one encounters three distinct zones as one moves into a reed bed (Báldi 1999, 1699, 1701). At the outer edge, to a depth of a metre or so, is a dense band of rather thin, short reeds. This gives way to a less tightly packed zone of much higher, thicker reeds. Here the temperature, light and wind intensity drop markedly and the humidity rises. Beyond this, as one moves deeper into the reeds (between 10 and 15 m), the height and density drop lowering the humidity and raising the available levels of light and temperature. These different zones are further reinforced by the fauna they support, the greatest number and diversity of bird species for example favouring the outer 5 m of the bed (Báldi and Kisbenedek 2000, 456–58). Put simply there is a marked sense of transition as one ventures into (and through) a reed bed.

It is also from the relic channels and reed beds that the waters rose during the flood seasons, further highlighting the transitional and liminal qualities of this zone. The temporal dynamic of the rising and falling waters, linked to the gradual seasonal dynamics of the flora and fauna forming the beating heart of the taskscape.

Looking to the question of the feasibility of fixed garden plots, the areas of essentially dry ground within the perceptual catchment can be easily calculated. For example, to the north of the site (across the Kiri-tó channel) is an area of 73.5 hectares of available ground. There is a further 117 hectares of dry ground directly adjacent to the site to the south and east. If we only consider areas that were not only within the catchment but also in direct view that still yields 55.17 hectares to the north and 94.93 to the south and east. This suggests that there was adequate dry ground in the vicinity of the site to support intensive garden cultivation (and see Bogaard *et al.*, chapter 23).

Any attempt to consider in detail the relationship between Ecsegfalva 23 and the other Körös culture sites in the immediate landscape immediately raises questions regarding issues such as seasonality (and see chapters 14–24) and assumptions of contemporaneity. As a result, the observations presented here must remain tentative. For example, it is interesting to note that while three site locations intrude upon the perceptual catchment *(Fig. 3.19)*, in each case they fall within the zone of ambiguity at the edge of the area: like the relic channels, spatially close yet perceptually hidden.

When we incorporate the viewshed *(Fig. 3.20)*, it is striking how these Körös culture site locations fall within the perceptual catchment yet are out of sight. Like the reed beds and relic channels these are locations that simultaneously afford both presence and absence, intimate enough to become a part of the everyday landscape of Ecsegfalva 23 yet shielded from direct view. They are first and foremost places that have to be visited. If firstly we follow the palaoebotanical evidence and assume some degree of fixedness in the landscape, and secondly contemporaneity between at least some of the sites, this suggests a complex series of negotiations were taking place within the landscape with a considerable degree of blurring, overlap and encounter within the taskscapes. As well as highlighting the inadequacy of the static catchment presented

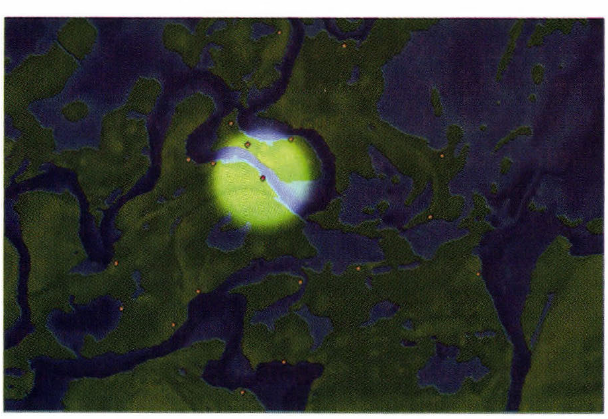


Fig. 3.19. Integrating the Körös culture sites

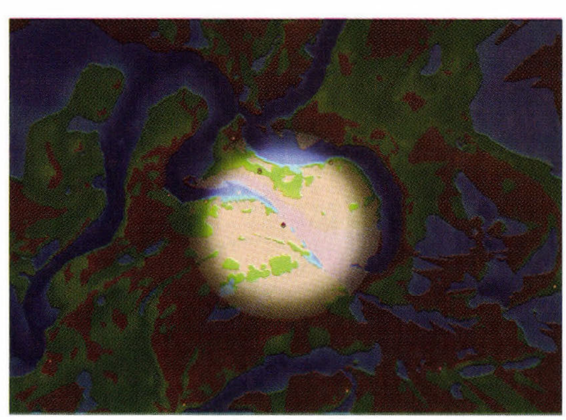


Fig. 3.20. The Kiri-tó meander incorporating the viewshed and Körös culture sites

here, this serves to stress the fact that whilst the settlements would have been out-of-sight, they most certainly would not have been out of mind – each community *aware* of the others dwelling within the landscape, presenced through physical encounter, knowledge, memory, snatches of sound and glimpses of smoke rising from distant hearths.

Summary and conclusions

Through the detailed modelling of the topography of the Kiri-tó and analysis of its hydrological and terrain characteristics, a representation of the Körös culture landscape of Ecsegfalva 23 has been generated. This has not only enabled the effects of seasonal dynamics such as flooding, as well as factors such as vegetation, to be assessed but also enabled the spatial and visual relationship between the site and its surrounding landscape to be explored.

Looking to the latter, whilst the spatial analysis of the site location confirmed the long recognised relationship between Körös sites and water – the site occupying a unique ridge location directly adjacent to the flood-zone – alternative frameworks have been put forward for reading this relationship. These are frameworks that emphasise the role of the flood events in the everyday life of the floodplain rather than the simple dictates of risk and profit. The visual analysis served to highlight the dual nature of the floodplain, at first glance laid open and exposed, yet concealing within its body a series of hidden zones corresponding to the channels from which the flood waters arose. These are areas that had to be journeyed to and visited, the sense of liminality and transition engendered by any movement between these zones further enhanced by the reed-beds that choked these out-of-sight places. The visual analysis also served to highlight how despite the inherent flatness of the terrain, the presence of vegetation served to draw the field-of-view in to the site, in visual terms closing it down dramatically.

In attempting to explore the act of dwelling at Ecsegfalva 23 an attempt was made to define and map the taskscape of the site. Though at best a partial surrogate, a form of perceptual catchment was proposed and implemented that enabled a much more subtle reading of the landscape of the site to take place. This once again emphasised the complex and intimate relationship that existed between the site, the temporal dynamics of the flood zone and the transitional nature of the reed beds that clustered within it. It also drew attention to the subtle relations between perceiving and directly seeing that that may have existed between human communities in the flood plain. First and foremost it stressed how the immediate world of Ecsegfalva 23 was dominated by the Kiri-tó.

Although predominantly descriptive and qualitative it is hoped that these observations will act as both a stimulus for interpretation and a catalyst for further GIS-based investigation of the Körös landscape.

Acknowledgements

Thanks to: Anthony Gouldwell for stimulating discussions regarding vegetation dynamics; Amy Bogaard and Kathy Willis for valuable advice in determining the optimum height of tree species; and Jeremy Taylor for insightful, critical feedback on the overall text.

Chapter 4

A LONG HISTORY OF THE KIRI-TÓ MEANDER

Sándor Molnár and *Pál Sümegi*

The geographical setting of the Kiri-tó meander

The study area lies in the heart of the Carpathian Basin right next to the former channel of the River Berettyó at the western edge of the village of Ecsegfalva at N 47 08' 06", E 20 53' 60" *(Fig. 4.1)*. The major rivers important for landscape evolution (Tisza, Hármas-Körös) are located some 10 km away from the pilot area. The former Kakat creek, breaching the natural levée at the village of Abádszalók creating the so-called Mirhó crevasse-splay ('Mirhó-fok'), used to serve as a key hydrological link towards the River Tisza in historic times *(Fig. 4.2)*. The meander of Kiri-tó is situated right at the interface of three minor landscapes, the Szolnok–Túr Lowland, the Dévaványa flat and the Nagy-Sárrét, with the Hortobágy-Berettyó main channel forming the present-day borderline. As the area of Kiri-tó is to the south of the main river bed, it constitutes a part of the Dévaványa flat today. Though this minor landscape is of the lowest relief in Hungary (Marosi and Somogyi 1990), in the direct neighbourhood of the lake significant elevation differences can be observed even in a relatively small area.

The Dévaványa Protected Landscape Territory was established in 1975 in order to conserve the treasures of the natural environment. This region was assigned to the area of the Körös–Maros National Park in 1997, at the time of its foundation, under the name 'Dévaványa-Ecsegi puszták' ('pusztas' or steppes), embedding the mosaic-like, scattered steppe areas located between Dévaványa, Túrkeve and Ecsegfalva (7200 ha), along with the surviving gallery forests on the active floodplain of the Berettyó. As these areas harbour the populations of the highly protected Great Bustard (*Otis tarda*), recorded in the Red Book as well, the rutting sites of this species enjoy greater protection. The 700 m long and approximately 100–120 m wide cutoff channel of the Kiri-tó

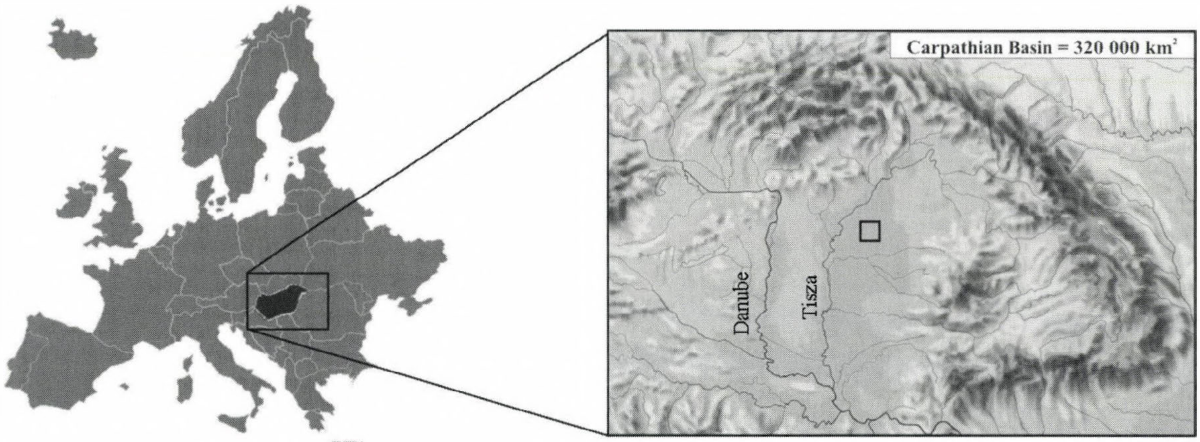


Fig. 4.1. The location of the study area

Fig. 4.2. The Mirhó-fok, an artificial crevasse splay connecting the Tisza and Berettyó rivers used during the Middle Ages

Fig. 4.3. Aerial view of the Kiri-tó and its surroundings

forming an oxbow lake is located at the margin of this highly protected region. The following protected areas are in the direct neighbourhood of the lake: Kórézug, Kelemenzug, Ecsegpuszta *(Fig. 4.3).*

Geological settings and evolution

The Great Hungarian Plain, or 'Alföld' in Hungarian, is the largest sedimentary basin in Europe infilled with Neogene sediments of great thickness. The geological evolution of the Pannonian Basin commenced during the Miocene. Parallel with the uplift of the Carpathian mountain arch, the inner parts of the surrounded territory began to subside. The Pannonian Sea, a subsidiary of the Tethys Sea, intruded into this newly developed basin. The Late Tertiary marked the deposition of 2000–3000 m thick marine sediments (conglomerates, sandstone, marls, clays), followed by the accumulation of 1000–2000 m thick lacustrine deposits. At the terminal part of the Tertiary, the basin bottom was turned into dry land due to the epirogenetic rise of the Carpathians. Fluvial sedimentation started in the inner parts at about the beginning of the Quaternary. As a result of the fluvial activity, 600–700 m thick sedimentary sequences accumulated in the deepest parts of the basin (Sümeghy 1944; Rónai 1985).

Some Pleistocene-Holocene neotectonic depressions, the Csongrád Basin, the Körös Basin, and the Szarvas Basin are situated in the studied region (Borsy and Félegyházi 1983; Rónai 1985; Borsy *et al.* 1989; Borsy 1990; 1995). The differential subsidence of these sub-basins fundamentally determined the course of water flows within the Carpathian Basin, as well as the type and rate of sediment accumulation (Sümeghy 1944).

The main river of the Great Hungarian Plain, the Tisza with its tributaries was flowing across the Körös and Szarvas Basins until the beginning of the Weichselian *(Fig. 4.4).* Approximately 30,000 years ago, successive tectonic events interrupted the accumulation of alluvial sediments in the area. Afterwards, primarily due to tectonic causes, the Tisza was running in the present-

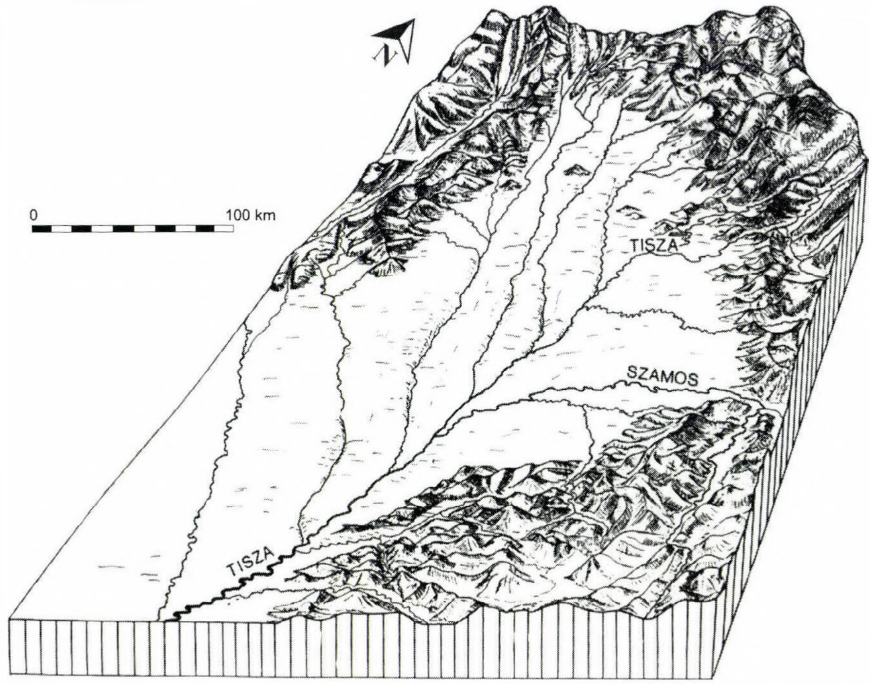


Fig. 4.4. Tisza river in the Ér-valley during Early Würmian (Borsy and Félegyházi 1983)

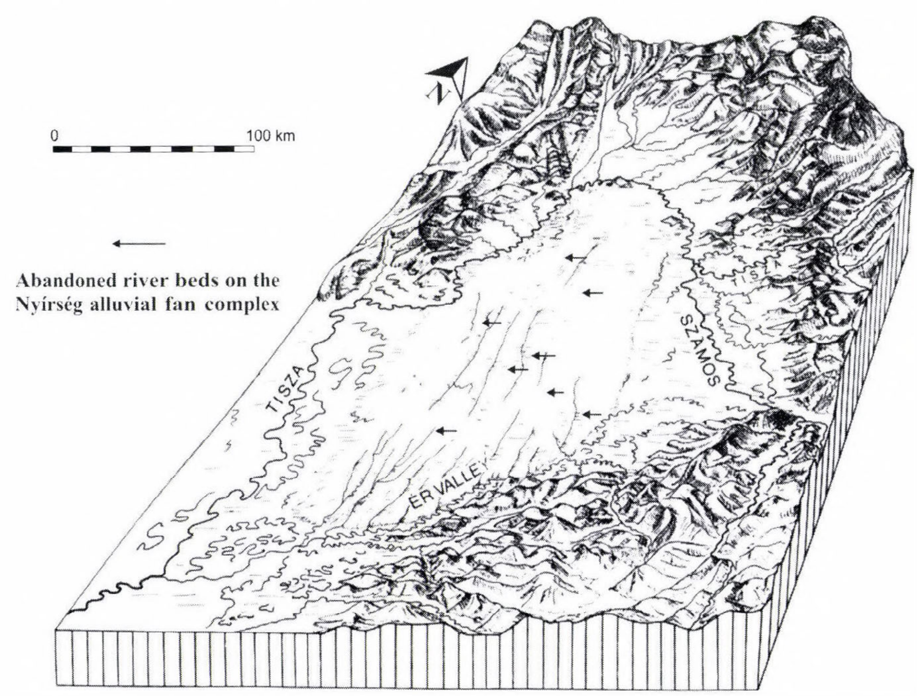


Fig. 4.5. Tisza river leaving the Ér valley at the end of the Middle Pleniglacial (Borsy and Félegyházi 1983)

day Ér-valley (Borsy 1995), which is located at the interface of the Transylvanian Mid-Mountains, and the eastern part of Great Hungarian Plain.

A process of subsidence, more intensive than ever before, started in the Bereg and Szatmár Plains during the Late Pleistocene (Sümeghy 1944). In consequence of the subsidence, a completely new network of watercourses developed which in the course of their erosion and accumulating work transformed the sinking areas into floodplains. This subsidence was, for a time, counterbalanced by the aggradational work of the river. In the Middle Pleniglacial, the Tisza after leaving the Ér-valley meandered over the area of the Bereg and Szatmár Plains from the north to the south *(Fig. 4.5)*.

Riverbed displacements were thus quite frequent (Borsy and Félegyházi 1983; Borsy 1995) in the Great Hungarian Plain during this time. As a result of these hydrogeological transformations, a large number of fossil Pleistocene meanders, and alluvial surfaces were left without active water flows. A similar Pleistocene lag-surface can be found around the region analysed. Thanks to the neotectonic movements of the Holocene, the River Berettyó cut itself into the older deposits of the Pleistocene alluvia. As a result of this, the older Pleistocene alluvia got into a relatively higher position forming elevated lag-surfaces, free of floods.

The climatic conditions of the Ecsegfalva region

The climate of the Carpathian Basin is by no means uniform, as it comprises an interface of several climatic belts. Several minor climatic influences play an important role in the formation of the climate like the Oceanic, Continental, and Sub-Mediterranean influences (Bacsó 1961; Zólyomi *et al.* 1992; Sümegi 1998). The effect of the Oceanic influences decreases from the west to the east with an opposite trend in the Continental influences, accompanied by a gradual decrease of the Sub-Mediterranean effect from the south to the north in the area of the basin. As a result of these, significant differences may develop between the annual temperatures and rainfall distributions of the area. However, some longer periods can clearly be distinguished lasting for some decades, when either of the above mentioned influences is prevalent.

The rate of average annual rainfall is rather low in the surroundings of Ecsegfalva, being around 530 mm on the average, concentrated mainly during the summer months *(Fig. 4.6)*. How-

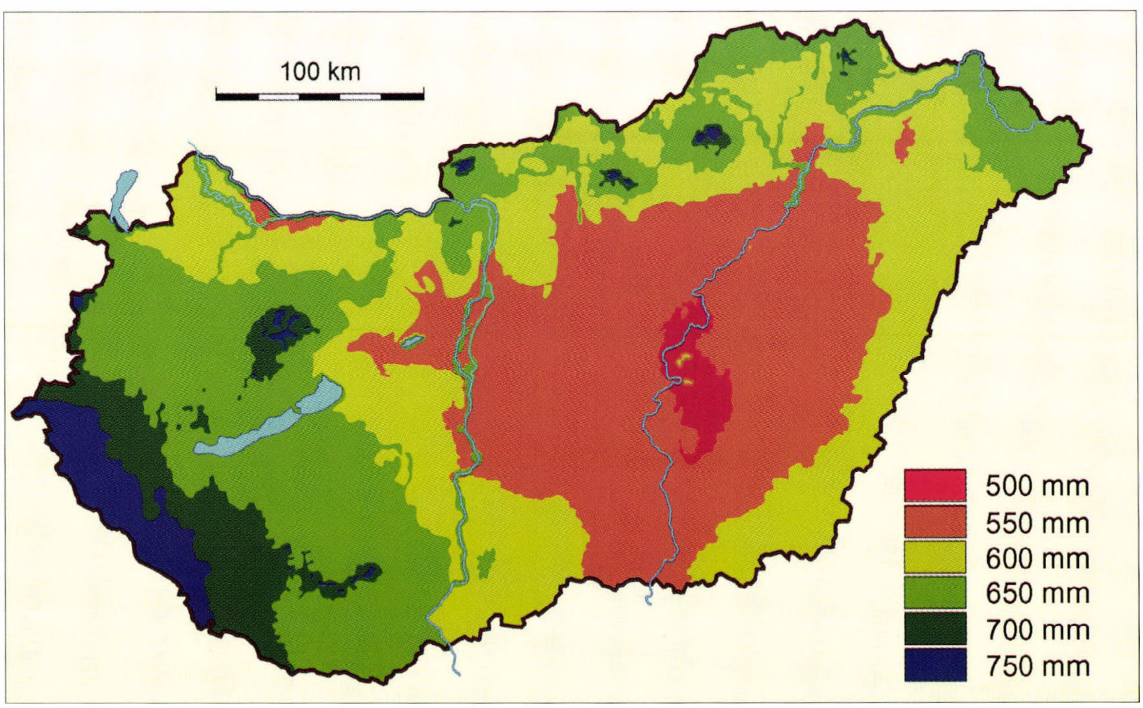


Fig. 4.6. The amount of average annual precipitation for the area of the Kiri-tó

Table 4.1. Average amount of the precipitation (mm) monthly, yearly, summer term and winter term. OMI (Hungarian Institute of Meteorology) 1967

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	year	IV–IX.	X–III.
Ecsegfalva	27	28	32	44	55	68	54	52	43	47	46	37	533	316	217
Túrkeve	26	28	32	43	55	68	52	52	42	48	47	36	529	312	217

Table 4.2. Average monthly and yearly temperature (°C) in Túrkeve. OMI (Hungarian Institute of Meteorology) 1967. Temperature change = difference between lowest and highest monthly average (e.g. –2.4+21.8 = 24.2)

I.	II.	III.	IV.	V.	VI.	VII.	VIII.
–2,4	–0,5	5,1	10,7	16,2	19,5	21,8	20,9
IX.	X.	XI.	XII.	annual	IV–IX	fluctuation	
16,6	10,8	4,6	–0,1	10,3	17,6	24,2	

ever, significant differences can be observed in the precipitation inputs of the area under study with the highest values being around 800 mm, and the lowest hardly reaching 300 mm *(Tables 4.1–2)*. Nevertheless, these larger amounts are still not sufficient to make up for the demands due to the high summer temperatures and the increased rate of evapo-transpiration. The aridity index can be easily calculated following the equation H = 1760/2,5°C, taking into account the average annual Hungarian rate of radiation (1760 MJ°m^{-2o}year^{-1}) (Péczely 1979). The calculated aridity index for the area is H = 1.33. Based on the average summer temperature values (t_v = 17,6°C), the studied area could have been classified into the warm and dry climatic region, similarly to other parts of the Great Hungarian Plain (H > 1.15 → dry; t_v > 17,5°C → warm). As such, the studied area belongs to the group of temperate forest-steppes based on its climatic parameters *(Fig. 4.7)*. This regional climate has been modified by the annual floods of the River Berettyó and its alluvial plain enjoying ideal hydrologic support. Consequently, groundwater levels in the surroundings of the Kiri-tó have been primarily determined by the net rainfall reaching the catchment area of the Berettyó rather than the local precipitation intensities.

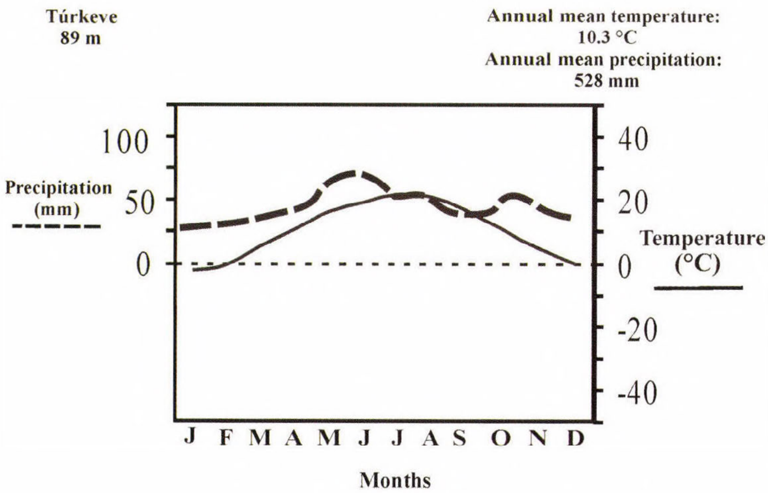


Fig. 4.7. The climatic description of the Ecsegfalva region. Walter-Lieth climate diagram based upon mean temperature and precipitation data for the Túrkeve meterological station

The flora and the fauna of the surroundings of the Kiri-tó

The study area of the Kiri-tó forms a part of the 42636 ha area of the Körös–Maros Area National Park, established in 1996 by the unification of mosaic-like scattered areas, which had enjoyed protection previously as well. This area is bordered by several significant water courses like the Maros, Tisza and the Körös rivers. Furthermore, the largest marshland area of the Carpathian

Basin, the Sárrét, can be found at the northern edge of the study region. The relative northern, western and to a lesser degree southern isolation of the study region and the respective eastern openness, has favoured the establishment of links with the area of the Transylvanian Basin regarding terrestrial species. Connections with the areas to the east are prevalent in case of the aquatic species as well, predestined by the east-west trend of the valleys of the Körös and Maros rivers. All these endowments favoured the emergence of a unique flora and fauna characterised by a higher ratio of Continental and Ponto-Mediterranean elements, the presence of postglacial relict as well as common endemic forms with the Transylvanian Basin.

Habitats adjacent to the study area of the Kiri-tó have undergone significant transformations for the past few decades. The habitats managed to preserve relatively high heterogeneity despite the small size of the area and their former overexploitation. The minor, muddy depressions, formed as a result of intensive treading by animals, transformed the meadow vegetation into a set of highly heterogeneous habitats displaying micro-scale complexity or mosaic patterning. Species of *Puccinella limosa, Pholiurus pannonicus, Plantago tenuiflora, Matricaria camomilla, Polygonum aviculare* inhabit the muddy surfaces.

The grasslands of the banks of the creek are highly disturbed lacking any structure and are closest to the Sage-Marrubium association (Salvio-Marrubietum peregrine: Mucina 1981). Besides the grasses and generalists the following species are the most common: *Carduus acanthoides, Convolvulus arvensis, Carduus nutans, Lythospermum arvense, Verbena officinalis, Cirsium arvense,* and *Galium aparine, matricaria maritima subsp. inodora.*

Loessy meadows (Cynodonti-Poeticum angustifoliae Rapaics ex. Soó 1957) appear as minor patches in the area as well and are characterised by generalists and higher species richness.

The channel of the Kiri-tó is mainly occupied by a bulrush marshland; with marginal associations of Agrostio-Beckmannietum eruciformis (Rapaics ex Soó 1930), regarded as remains of the continental alkaline steppes (*Beckmannia eruciformis, Glyceria fluitans, Carex vulpina, Glyceria maxima, Iris pseudacorus, Butomus umbellatus, Agrostis stolonifera, Eleocharis palustris, Bolboschoenus maritimus, Alopecurus pratensis, Typha laxmannii, Lycopus europeus, Lythrum salicaria, Juncus bufonius, Roroppa kerneri,* and *Typha angustifolia*). The open water areas located at the edge of the bulrush marshland are inhabited by species of bladder-wort and pondweed. Furthermore, some remains of hardwood gallery forests (*Fraxino-pannonicae Ulmetum*) can be found on the Holocene alluvia.

As a result of the newer landscape management techniques and approaches implemented in the present-day protected area, a relatively rapid remediation of the meadows can be observed with a trend pointing towards secondary Achillea steppes. The remediation on the banks is significantly slower, with a lush bulrush vegetation occupying the channel today and lacking any open water areas, as a result of the cessation of goose grazing in the area.

The barren surfaces and the vegetation-free beaches offer ideal habitats for several unique bird species. The shallow waters serve as not only an ideal meeting point but nesting place as well for the species of pewits, red-shanks, and godwits. The bed of the pond itself is covered by narrow-leaved bulrushes (*Typha angustifolia*) and reeds (*Phragmites australis*) with scattered open water areas offering a nesting place for avian species like coot, marsh-hen, duck-hawk, or runner.

The human impact and the archaeological sites

The present paper is concerned with the tracing of alterations in space and time throughout the study area, which can be closely linked to human activities and the accompanying landscape utilisations on the basis of data taken from the literature (Hungarian Archaeological Topography: Ecsedy *et al.* 1982) and archaeological excavations, as well as the application of geoinformatical tools.

In order to accomplish this task a detailed digital elevational model (DEM) has been prepared and used for the area with the assistance of geophysicist Gábor Timár (Timár 2003), instead of the barely usable maps available for the study area. On to this DEM the sites of the given human cultures were applied. This type of approach provides for a much more spectacular visualisation of the distribution of archaeological sites.

The spatial distribution of human groups has been depicted with the help of this map series for ten different phases, embracing a period from the Early Neolithic Körös culture up to medieval times.

The density of sites had to be determined for the wider surroundings of the studied area as well because of the large-scale uncertainty present in the archaeological data deriving from the selective preservation of sites due to varying factors. The results give us a good view of the nature of changes within the human populations, showing whether these were local or regional in importance. In accordance with previous studies (Sümegi 1998), the number of sites located within a diameter of 50 km around the study area were taken into consideration. The surroundings of the Kiri-tó occupy an interface formed by two counties: Jász-Nagykun-Szolnok and Békés. In contrast to the area of Békés county, there is no available data for the area of Szolnok county, due to the lack of archaeological topographic surveys in that region.

Records of the archaeological topographical survey implemented in the Szeghalom circle of Békés county, which was also the first of such publications from the area of the Great Hungarian Plain, were used as a basis for the analysis of the study area. The related fieldwork and the analyses of other resources were carried out between 1969 and 1975. The lack of sufficient financial support allowed for the compilation of surface finds only and the implementation of some sample excavations. In the majority of cases, the sites were designated as settlements no matter whether or not they had yielded relatively low numbers of archaeological finds, which is a quite unique approach. To eliminate such errors new excavations would be required, but this option is a rather time- and money-consuming one.

Several maps have been drawn as a supplement to the archaeological topographical survey. However, these were of relatively large scale, allowing for a schematic representation of the data only.

The following classification key was developed for the depiction of archaeological data on the DEM:

The sites were put into three major categories:

1. Excavated settlement site (black double square)
2. Assumed site of a settlement with abundant surficial material (black)
3. Assumed site of a settlement with sporadic surficial material (white)

The Copper Age burial mounds present in the studied area were assigned a separate key as well.

The early and late groups of the AVK (Linear Pottery culture of the Great Hungarian Plain) were depicted on separate maps where possible.

The first survey map depicts all the archaeological sites present in the studied area in black along with the burial mounds (red), and the inner parts of the village of Ecsegfalva (white).

As can be seen on the map, the sites are clustered into three main regions regardless of the fact that about 8000 years have passed since the first human settlement in the area. The remaining 'empty' regions have never been inhabited. The formerly mentioned clusters are restricted to the shores of the Kiri-tó, the Ecseg-tó (Ecseg Pond) and the Bessenyő-tó (Bessenyő Pond). All three areas have a similar geological setting and more or less equal ecological endowments. The ponds must have served as important potential water and protein resources (fishes, mussels). The

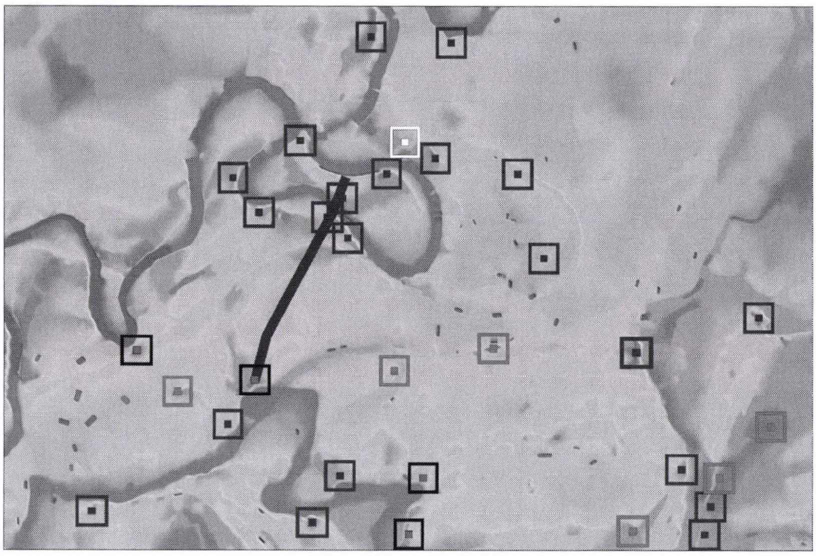


Fig. 4.8. All the archaeological sites of the investigated area (modified after Ecsedy *et al.* 1982). White square: Centre of present-day Ecsegfalva village. Black square with black dot: archaeological site. Black square with grey dot: Archaeological site with mound. Grey square: kurgan (so-called 'kunhalom')

vegetation which had developed on the water-influenced hydromorphic soils offered an ideal possibility for animal husbandry. The black earth soils, which had developed on the loess-covered elevated lag-surfaces must have provided the basis for crop cultivation. It was also these elevated lag-surfaces, which were relatively flood-free or covered with waters only during the times of extreme floods, that must have acted as sites for permanent human settlement as well *(Fig. 4.8).*

The earliest archaeological finds from the area are dated to the time of the Körös culture. The groups of the Körös culture in the Carpathian Basin represent the northernmost expansion of the cultures bearing Aegean-Anatolian roots (Kalicz 1980a). The Körös culture settlement established on the shores of the Kiri-tó is located along this line of northern expansion given by the valley of the Berettyó. Formerly, the halt in the expansion of these groups was interpreted in terms of hydrological conditions ('boundary river theory') (Szathmáry 1983a). The latest interpretations regarding the process of Neolithisation within the Carpathian Basin, however, are not so straightforward. According to one recently postulated model, certain environmental factors along with the cultural traditions and limit of technical innovations must have acted as limiting factors in accordance with the Liebig principle in the process of Neolithisation. The northern boundary of the culture, acting as a barrier for agricultural production has been referred to as the Central European Balkanic Agroecological Barrier (CEB AEB) (Sümegi and Kertész 1998; Sümegi 2003c). The Balkanic type of agricultural production was unable to pass this barrier, being forced to remain in the Carpathian Basin for a longer period of time, enabling the long-term survival of Mesolithic groups formerly present in the area and the later emergence of a new, local Neolithic culture.

As a result of the emergence of permanent settlement types a special so-called tell structure developed from the end of the Early-Middle Neolithic. Villages of smaller size were able to persist in the marginal areas of the Carpathian Basin only. Agricultural production must have provided for the needs of the inhabitants.

Consequently, the possible environmental influences of these settlements can be primarily linked to agricultural production as well. Thanks to the low numbers of the inhabitants, the wider surroundings must have been affected only to a lesser degree. However, the natural vegetation

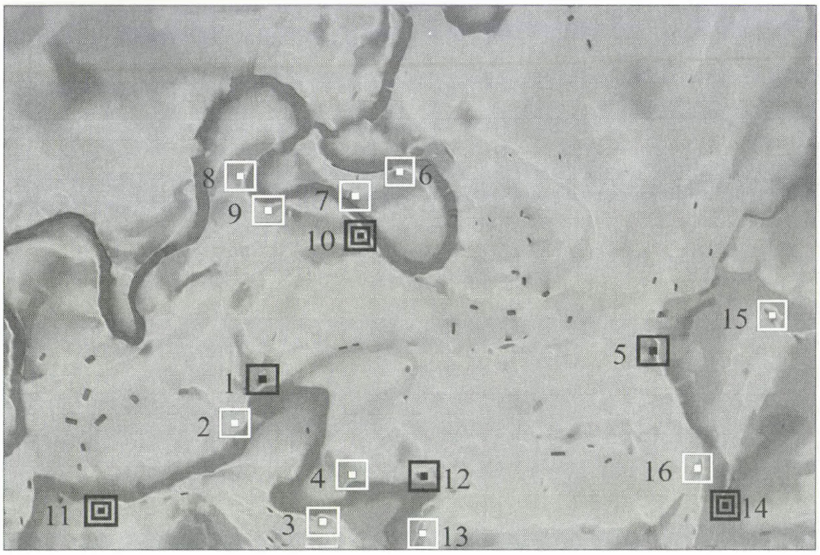


Fig. 4.9. Archaeological sites of the Körös culture (modified after Ecsedy *et al.* 1982).
Double lined black square: Excavated settlement. Black square: not excavated/presumed archaeological site with abundant archaeological remains on the land surface. White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

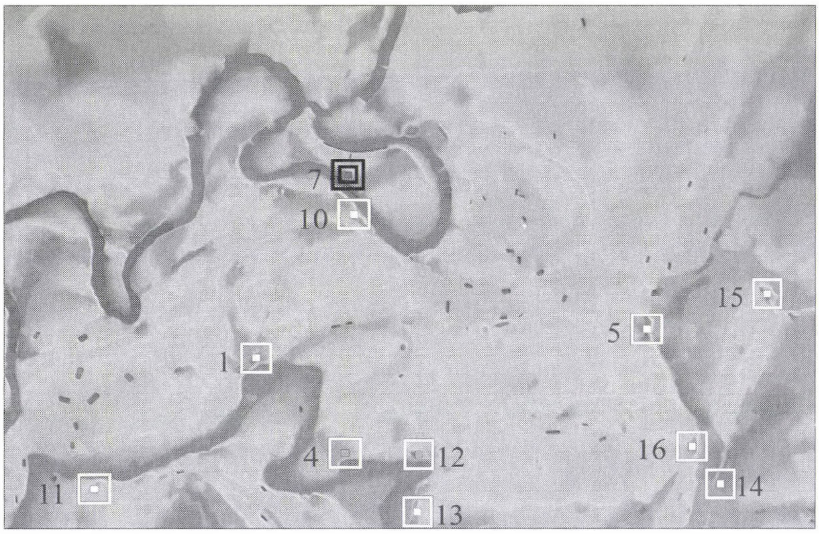


Fig. 4.10. Archaeological sites of the Linear Pottery culture (modified after Ecsedy *et al.* 1982).
Double lined black square: Excavated settlement. White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

adjacent to the settlement might have suffered more significant alterations *(Fig. 4.10).* Deforestation must have affected primarily those areas, which were most ideal for crop cultivation: the elevated lag-surfaces. Wood must have been used for heating the furnaces necessary for burning clay pots as well. The weeds tolerating treading must have undergone a significant expansion parallel with these transformations, indicating a relative degradation of the studied area.

The second stage in the Neolithic evolution of the area is represented by a peculiar transitional cultural group bearing local, Central European cultural elements besides the Mediterranean ones: the AVK or Linear Pottery culture of the Great Hungarian Plain. This group is a transition between the Körös and DVK (Linear Pottery culture of Transdanubia) groups. The villages may

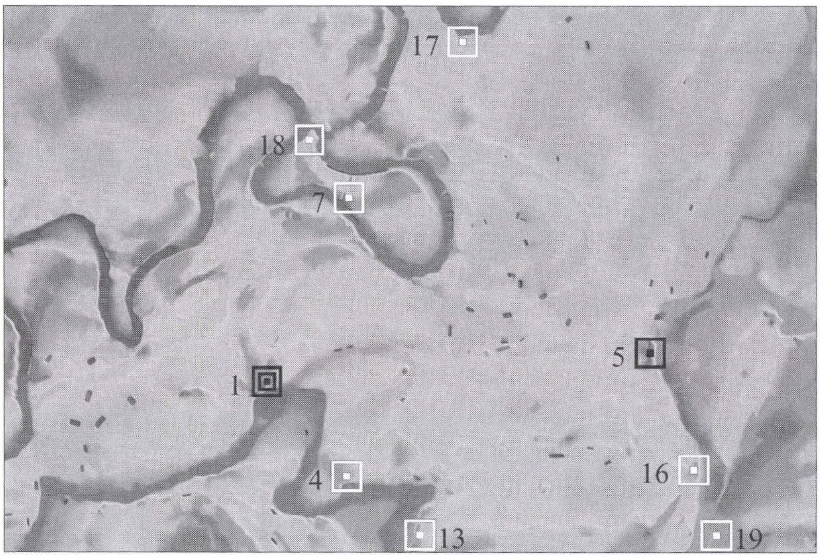


Fig. 4.11. Archaeological sites of the Tisza culture (modified after Ecsedy *et al.* 1982). White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

have had a relatively large population, leading to the rapid exploitation and depletion of natural resources in their direct neighbourhood. This initiated a migration to new areas offering favourable living conditions. However, the constrained possibilities for movement and migration very often led to the re-colonisation of formerly deserted settlements via the establishment of new houses on top of the ruins of the former settlements (Kalicz 1980a).

This culture broke up into several individual groups during the late phase of its evolution. The representatives of one of these outcomes, the Szakálhát group, occupied the southern half of the Great Hungarian Plain. Their settlements were permanent and tell-like. An Early AVK settlement can be found in the surroundings of the Kiri-tó *(Fig. 4.8).* Land degradation was another important form of landscape disturbance caused by agricultural production in the area at the time.

At the end of the Neolithic, a new cultural group emerged with stronger Mediterranean ties in the area of the southern Great Hungarian Plain closely related to the Szakálhát group: the Tisza culture. This cultural group was similarly characterised by extensive tell-like settlements indicating permanent and significant settling of humans in the area. Animal husbandry was also important besides the rotational crop cultivation. Very few finds have so far come to light from this culture in the surroundings of the Kiri-tó. This region must not have been ideal for long-term permanent settling, preventing the development of an individual settlement. As such, environmental disturbance was only minimal at this time, enabling the remediation of the natural vegetation *(Fig. 4.11).*

Landscape development took a totally different direction parallel with the appearance of the Tiszapolgár culture during the Copper Age. The settled lifestyle and crop cultivation were replaced by pastoralism, rendering the settlements temporary as well. Thanks to the extensive metallurgy, it was the close neighbourhoods of ore mines and smelteries that suffered the most significant transformations. These influences are much less accentuated in the area of the Great Hungarian Plain. Large-scale deforestation activities were closely linked to the establishment of new extensive pasturelands *(Fig. 4.12).*

The trend of events was quite similar during the Bodrogkeresztúr culture. This culture is represented by very few finds in the surroundings of the Kiri-tó, and thus human influences were not as significant either *(Fig. 4.13).*

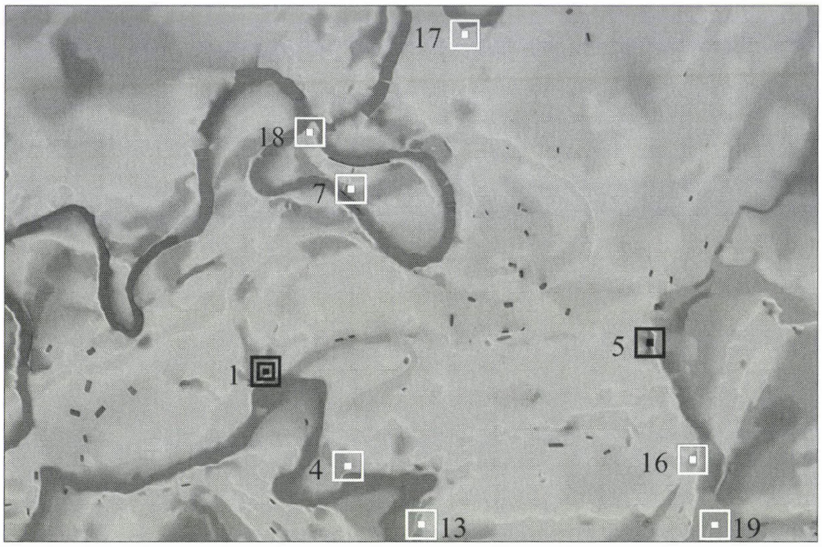


Fig. 4.12. Archaeological sites of the Tiszapolgár culture (modified after Ecsedy *et al.* 1982).
Double lined black square: Excavated settlement. Black square: not excavated/presumed archaeological site with abundant archaeological remains on the land surface. White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

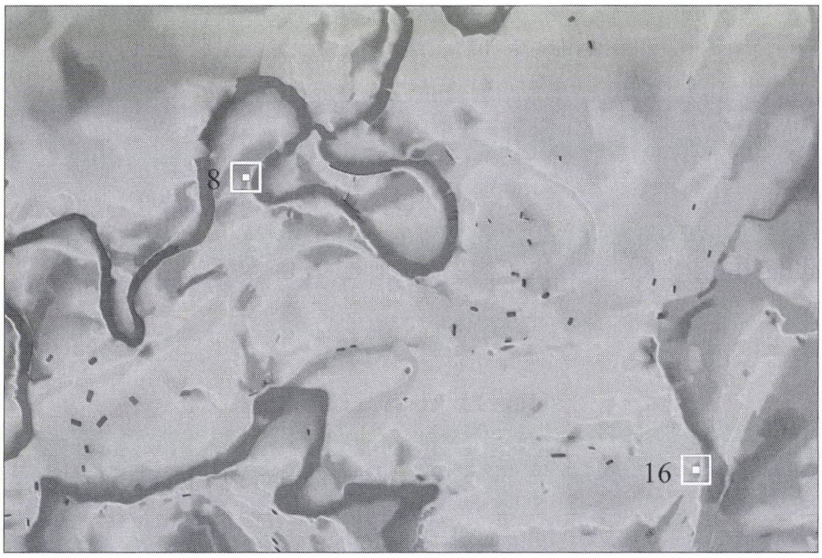


Fig. 4.13. Archaeological site of the Bodrogkeresztúr culture (modified after Ecsedy *et al.* 1982).
White square: not excavated/ presumed archaeological site with sparse archaeological remains on the land surface

The end of the Copper Age marked the arrival of new groups coming in significant numbers into the area of the Carpathian Basin from the south. Crop cultivation managed to regain its former importance alongside animal husbandry. The number of copper tools was also significantly reduced. Only one such Baden culture site is known from the surroundings of Kiri-tó, and thus the environmental effects must have been less substantial as well.

At the end of the Copper Age, a new cultural group appeared within the Carpathian Basin characterised by a specific burial practice. The establishment of mounds above the graves resulted in a significant transformation of the landscape and the panorama as well. These Cumanian burial mounds, observable even today, had enhanced the natural remediation of the former vegetation, as they were not put under cultivation until the introduction of factory farms. Today all of them enjoy protection. Though there are a couple of sporadic mounds in the area south of the Kiri-tó, they tend to show up in larger numbers in the areas to the east, and south-east *(Fig. 4.14)*. There must have been approximately 40,000 burial mounds originally in the 100,000 km^2 area of the Great Hungarian Plain, but only 4000 of them have survived.

During the next 1000–1500 years, the close neighbourhood of the study area practically became deserted. There is no important archaeology in the area, apart from the sporadic traces of the Late Bronze Age Gáva culture (1300 cal BC), until the appearance of the Sarmatian groups (c. 100 AD) *(Fig. 4.15)*.

The scale of human activity increasing elsewhere during the Bronze and Iron Ages must have affected the study area to only a small extent. Or the area must have functioned as a some kind of backwater, as the lack of archaeology indicates. However, this must have been an ideal period for the remediation of the original flora and fauna or for the temporary cessation of landscape degradation at least.

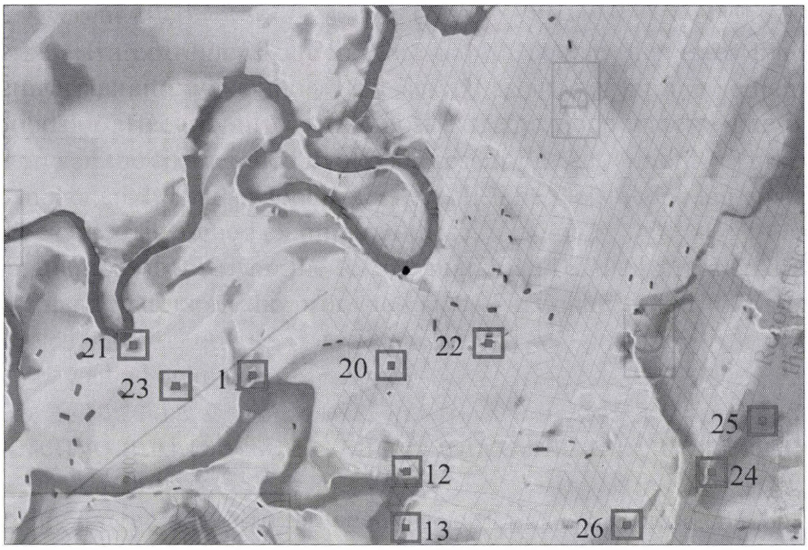


Fig. 4.14. Location of kurgans (modified after Ecsedy *et al.* 1982). Grey square: kurgan

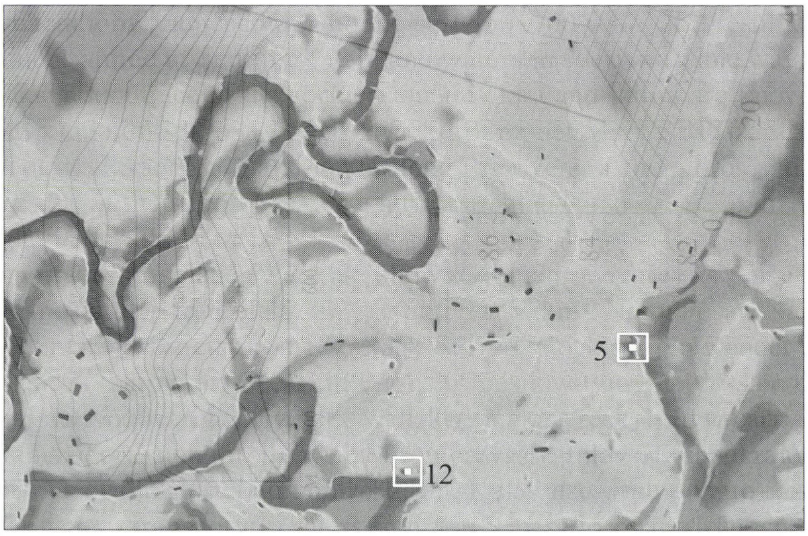


Fig. 4.15. Archaeological site of the Gáva culture (modified after Ecsedy *et al.* 1982).
White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

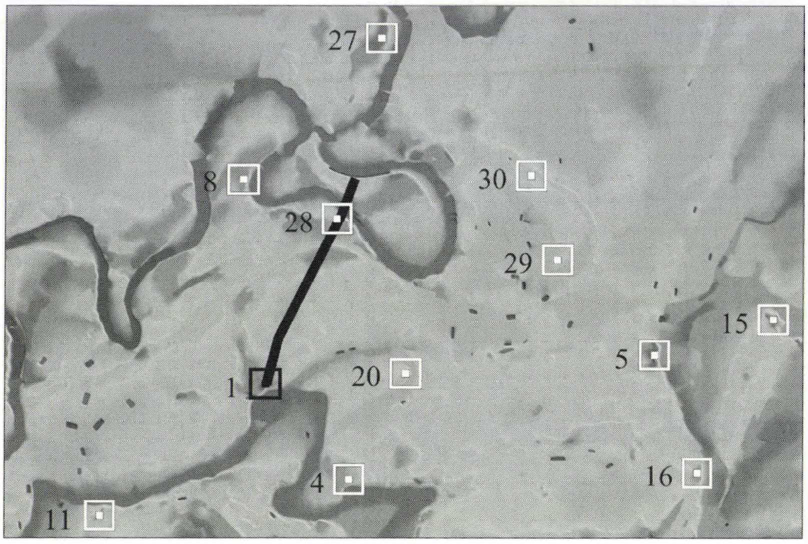


Fig. 4.16. Archaeological site of the Sarmatian period (modified after Ecsedy *et al.* 1982).
Black square: not excavated/presumed archaeological site with abundant archaeological remains on the land surface. White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface. Black line: Trench of Sarmatians (Devil's dyke in folk expression)

The first people of the Age of Great Migrations established permanent settlements in the area again. The number of settlements radically increased. Remains of entrenchments crossing the study area serve as further proofs. These once formed a part of a uniform defence line running through the northern edge of the Great Hungarian Plain and the foothills of the Transylvanian Mid-Mountains. The construction of the 'Ördög' (Devil's) or 'Csörsz' dyke with an approximate length of 1800 km must have brought fundamental transformations in the landscape and the original fauna and flora. In order to achieve the desired height and a sufficient stability, enormous amounts of wood must have been utilized. This must have been ensured primarily by the logging of the lowland woodlands. On the other hand, the newly developed entrenchment must have enhanced the long-term persistence of the steppe vegetation in the area, similarly to the Cumanian burial mounds.

The newer waves of the Great Migration must have left the area unaffected until the arrival of the Hungarian tribes. Only a single Avar graveyard is preserved within the boundaries of the village of Ecsegfalva *(Fig. 4.17)*.

The end of the Age of Great Migrations and the arrival of the Hungarian tribes opened up new relations and approaches between man and environment, but mainly restricted to the middle part of the Danube valley (see Sümegi 1998; 1999a; Willis *et al.* 1998).

Following the foundation of the Hungarian state, a new type of landscape management appeared causing transformations, namely the establishment of a controlled floodplain environment and the introduction of the so-called floodplain management.

The Middle Ages: written sources and maps relevant to floodplain management

Huge depositional hiatuses have been observed during the environmental historical analysis of several Hungarian cutoff channels and ponds on the watershed of the River Danube, dating back to medieval times (Sümegi 2000b). Later on, a complex network of entrenchments is found linked to the Danube valley, clearly indicating the presence of an extensive nature-friendly chan-

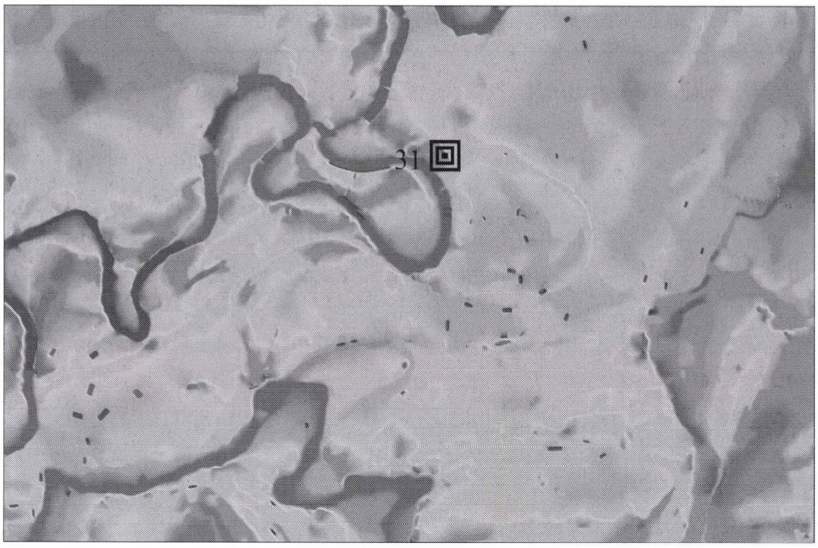


Fig. 4.17. Archaeological site of the Avar period (modified after Ecsedy *et al.* 1982).
Double lined black square: excavated settlement

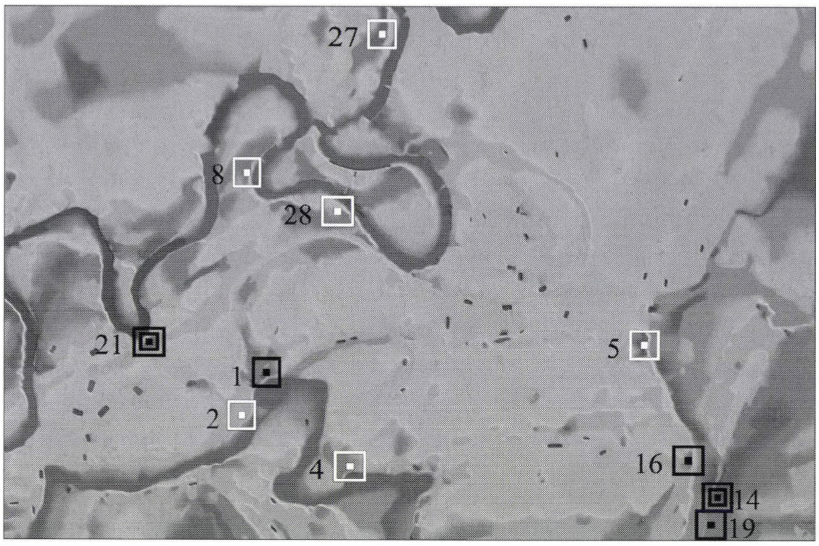


Fig. 4.18. Archaeological site of the Early Magyar period (modified after Ecsedy *et al.* 1982).
Double lined black square: Excavated settlement. Black square: not excavated/presumed archaeological site with abundant archaeological remains on the land surface. White square: not excavated/presumed archaeological site with sparse archaeological remains on the land surface

nel system, uniformly used in accordance with the natural endowments of the landscape from as early as early medieval times (Takács 2000). These findings are in accordance with our present knowledge of the techniques and approaches of medieval wetland and floodplain management derived from the written sources of charters and possessories (or general properties of a landlord in an area) (Andrásfalvy 1965; 1970; 1973; Károlyi and Nemes 1975; Bellon 1996; Győri 2000). The people inhabiting the area of the Danube valley must have discovered, even as early as the beginning of the Middle Ages, that a minimal transformation of the main river channels and its tributaries yielded a network of floodplains and cutoff channels with regulatable water flows, supporting fishing, logging and grazing on the floodplain meadows, as well as the establishment of orchards, without larger technical or material investments. These different types of landscape management approaches were always in balance with the prevailing environmental conditions in contrast to the river regulation policies of the nineteenth century. The intentional application of floodplain management, harmonising with the natural endowments of the landscape, the level of technical development, and human resources, enabled the improvement of several animal and plant species within the Danube representing the highest quality till the beginning of the industrial age.

Floodplain management

According to medieval written sources and maps, intensive floodplain management was present in the surroundings of the Kiri-tó during medieval times. The accompanying man-made temporary drainage works, riverbed and lake basin cleanings, as well as periodic floodings must be blamed for the observed depositional and chronological hiatus in the deposits of the area.

The notion of floodplain management based on the creation of a network of artificially controlled crevasse-splays (in Hungarian 'fok') is relatively unknown today calling for the need of a short overview. Tivadar Ortvay was the first to notice the system of fishing ponds accompanying the major rivers (Ortvay 1882) during medieval times. Nevertheless, it was Bertalan Andrásfalvy who investigated this type of landscape management and lifestyle in greater depth. Thus his works serve as the basis of our overview as well (Andrásfalvy 1970; 1973; 1975). Originally the term 'fok' or 'crevasse-splay' was used for the artificial breach in the higher natural levee accompanying the river, created in order to enhance a controlled outflow and retreat of flood waters into the floodplain from the riverbed via this valley-like depression. Later on, however, this term has been used for the larger depressions and cut-off channels enjoying water supply via these artificial breaches as well. The principle of floodplain management based on these artificial crevasse-splays is rather simple, letting water into the ponds on the floodplain from the rivers via these valley-like breaches functioning as 'gates'. The inward flow came from the upstream side of the cutoff channel with the outward flow leaving the channel from the downstream side, which was also the deepest part of the lacustrine basin *(Fig. 4.19)*. The main goal was to achieve the transportation of as little fluvial deposit as possible on to the floodplain during floods, and practically all water could have been driven away from the floodplain with the retreat of flood waters.

The intentional use of these crevasse-splays had several advantages:

1. It enabled a more balanced distribution of waters during the floods preventing unexpected water gaps or the intrusion of floods onto undesired areas, and the relatively sudden disposition of floodplain channels. Furthermore, the level of high waters could have been controlled by not a single crevasse-splay but a whole system of these, enabling the equal distribution of flood waters on the floodplains along the river.
2. The artificial drainage during the retreat of the flood waters prevented the long-term submergence of the floodplain vegetation, which could have led to their complete extermination.
3. It ensured sufficient numbers of fish as these temporarily flooded areas with shallow, still or gently flowing waters offered ideal spawning places for the fish of the river. Furthermore, the warm shallow waters were ideal for the growth of zoo- and phytoplanktonic organisms as a food source for fish and enhanced the rapid development of the spawns.
4. The short-term submergence enhanced the fertility of the soils of orchards, pasturelands, hayfields, and woodlands.
5. The artificial channels could have been utilised for water transportation as well.

The legendary abundance of fish in the waters of medieval Hungary can be attributed to this type of landscape management. The spawning fishes wandering on to the shallow waters of the floodplain with the floods were relatively easy to catch via sophisticated fishing equipments (stake nets, hoop nets) which blocked that side of the channel where waters were pouring out. The spawns could easily get through the holes of these, thanks to their smaller size, ensuring the survival of stocks.

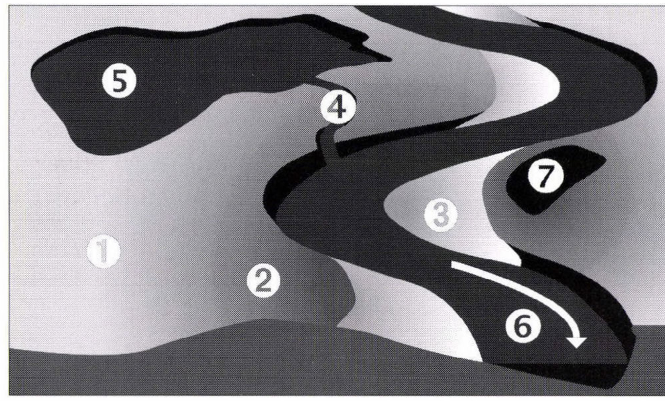


Fig. 4.19. Situation of 'fok'. 1: Flood plain; 2: Natural levee; 3: Point bar; 4: 'Fok'; 5: Lake; 6: Downstream; 7: Village

However, there are other important benefits of flood waters on the floodplain as well. For agroecology, the recurrent accumulation of organic-rich flood deposits on the floodplain was quite beneficial, enhancing soil quality via a continuous support of nutrients. These waters were also propitious for the hydrology of the floodplains, being most effective on the more continental lowland areas. The floodplain being more humid than the surrounding flood-free areas is free of long summer droughts as well. All these factors resulted in the emergence of a complex production and landscape management type on the areas of the floodplains. This nature-friendly approach was fully in harmony with the natural endowments and ecology of the area, exploiting its resources to the maximal possible extent.

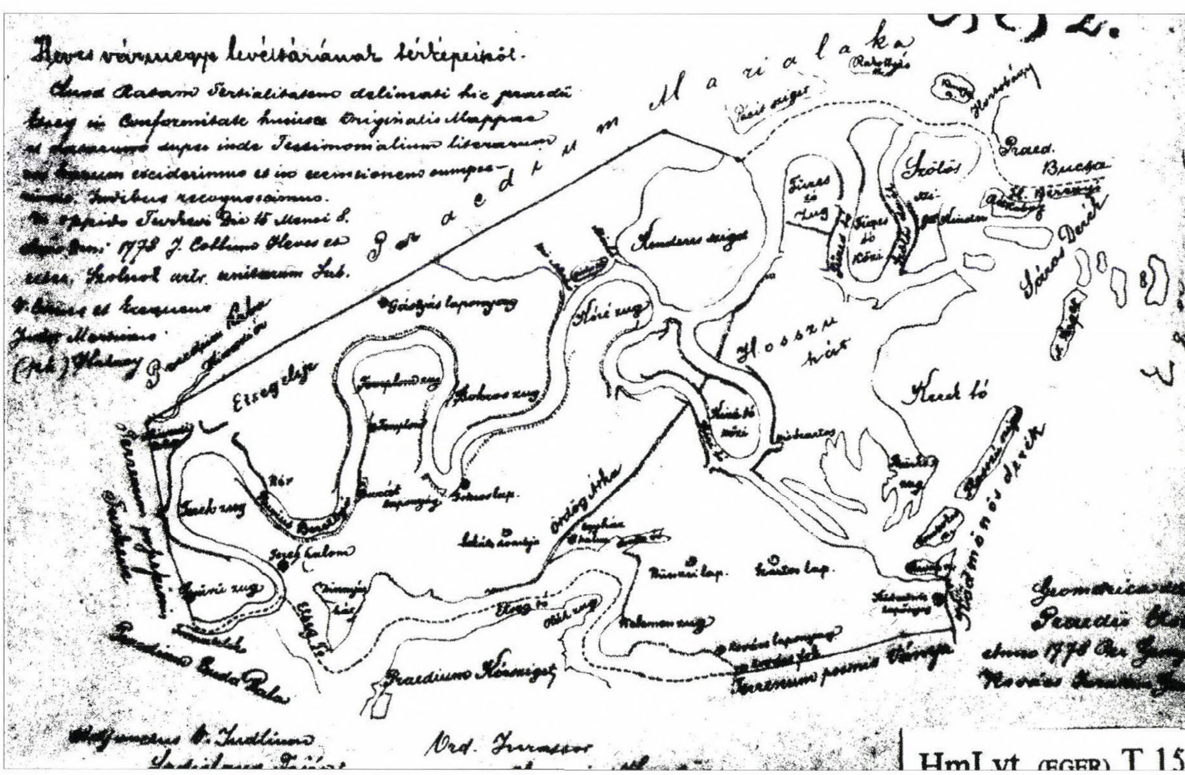


Fig. 4.20. The Pálos map depicting the area of the Kiri-tó

The population was engaged in different types of fishing using stake nets, hoop nets or regular nets, and the extensive exploitation of woodlands and meadows. The use of acorn as a fodder for pigs was rather prevalent in the oak gallery forests. The hardwood also supplied material for heating and the construction of various buildings like barns, mills or houses. The softwoods were used for preparing various vessels used for storage. The most important of these was willow splint. Besides gathering fruits from the woodlands, extensive floodplain orchards ensured the sufficient fruit supply of the population. The most frequently cultivated plants included apple, plum, pear and walnut. The fruit was either consumed on site or was traded. Other easily collectible and available plants like reed, bulrush, sedge or saligot as a wheat substitute were also important (Bellon 1996; 2003).

The abundant water fowl must have offered another food source. Not only the birds themselves were hunted via the utilisation of traps, daggers or loops, but their eggs and hatchlings were also gathered.

Fig. 4.21. Austrian military map from 1782

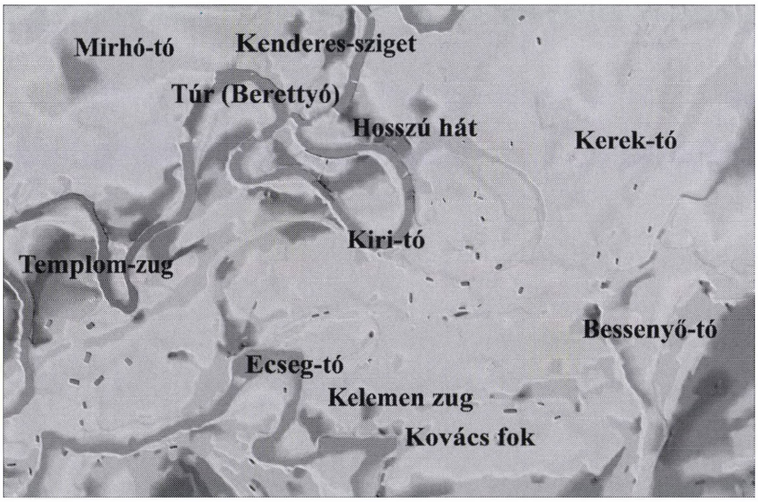


Fig. 4.22. The digital landscape model with the most important hydrological elements identified in the medieval sources

The elevated, flood-free river banks and plateaus offered ideal conditions for crop cultivation. On the whole, this type of floodplain management involved the versatile yet nature-friendly exploitation of the natural resources of the area.

According to the written sources (for the original Latin text, see Haan 1870) and maps prepared preceding the river regulations, this type of floodplain management was also prevalent in the surroundings of the Kiri-tó (Molnár 2002). These written sources are very important for further investigations of the relationship between man and environment.

A Medieval Age Pálos map, redrawn during the eighteenth century, depicts the area preceding the river regulations enabling the identification of the majority of sites and objects mentioned in the medieval charters and other written sources *(Fig. 4.20)*. The central position of the Kiri-tó within the network of artificial crevasse-splays along the River Berettyó, or Túr as it is mentioned during the Middle Ages, is clearly observable on this map. The channel of the Kiri-tó served as a hydrological link between the River Berettyó, the crevasse-splay pond of Mirhó, the Ecseg-tó, Kerek-tó, Besenyő-tó occupying abandoned riverbeds to the south of Ecsegfalva, and finally the Füzes-tó lying to the north-east of Ecsegfalva. From these above mentioned fishing ponds, which formed a part of the network under floodplain management, only the Kiri-tó remained to be a pond, while the rest were drained and ploughed. It is also the only pond that was depicted on the map of the 1782 military survey *(Fig. 4.21).*

The DEM of the area prepared for the better visualisation of the spatial and temporal distribution of the different archaeological sites was also very useful for capturing the relatively small-scale differences in relief and hydrology (and see Gillings, chapter 3). The features of the former floodplain management network are easily distinguishable on the DEM as well, with the help of maps and descriptions from the times preceding the river regulations *(Fig. 4.22).*

After the Turkish occupation, this floodplain management network declined and a hydroregulation process started during eighteenth and nineteenth centuries. The natural evolution of the alluvial plain on the Great Hungarian Plain ended under this hydroregulation process. The effect of this process will be shown in the next chapter.

Chapter 5

THE KIRI-TÓ MEANDER: SEDIMENTS AND THE QUESTION OF FLOODS

Pál Sümegi and *Sándor Molnár*

Geological and geomorphological conditions around the Kiri-tó meander

According to the results of the geomorphological investigations carried out in the surroundings of the Kiri-tó, and the analyses of aerial photographs and satellite images *(Fig. 5.1),* the gradually silting-up cut-off channel of the Kiri-tó formed an oxbow lake, whose surrounding river banks, and adjacent backswamps, though significantly deformed as a result of erosion and sediment accumulation, are clearly distinguishable. This juvenile geomorphological state has been preserved in an almost original condition because the study area developed a relatively elevated position forming a fossil lag-surface at a relatively early stage, preventing further landscape evolution (Sümegi 2000b; 2003b; Sümegi *et al.* 2002).

According to the geological investigations, the surface sediments are exclusively of Quaternary age *(Fig. 5.2).* On the other hand, the geological forms in the surroundings of the Kiri-tó can be classified into two major groups. One of these is the Holocene organic-rich, clayey flood-

Fig. 5.1. Aerial photograph of the Kiri-tó study area
□ excavated Kőrös site, ○ undisturbed cores for pollen analyses, A–A' B–B' the geological cross-sections

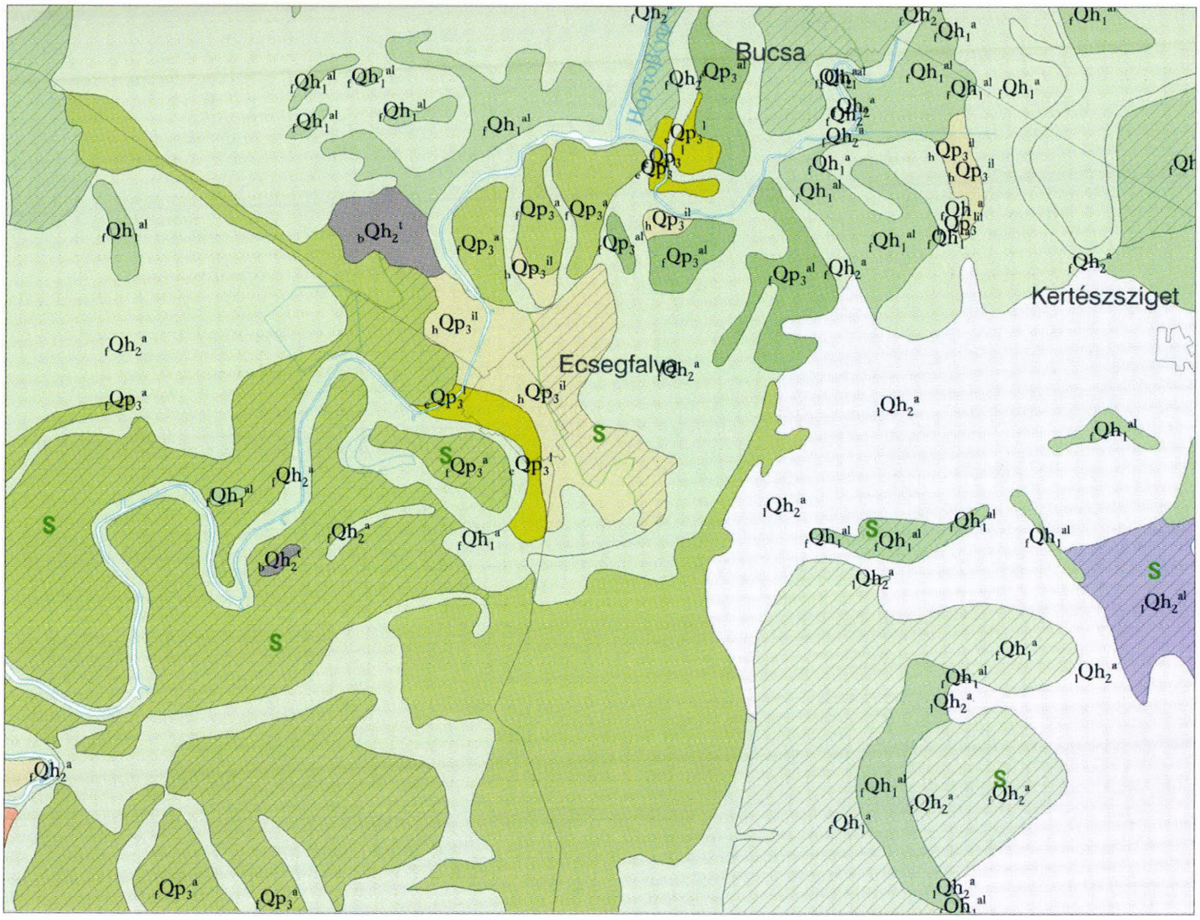


Fig. 5.2. The geological map of the Kiri-tó. Late Holocene: fQa,h2 = Late Holocene alluvial clay; fQalh2 = alluvial silt; lQal,h2 = lake silt; bQt,h2 = peat. Early Holocene: fQa,h1 = Early Holocene alluvial clay; fQal,h1 = Early Holocene alluvial silt. Upper Pleistocene: eQl,P3 = Upper Pleistocene loess; hQil,P3 = Upper Pleistocene infusion (alluvial) loess; fQal,P3 = alluvial silt; fQa,P3 = alluvial clay

plain deposits uniformly covering the valley of the River Berettyó. The other is made up of the island-like segments of Pleistocene loess-covered lag surfaces elevated above the surface of the floodplain as a result of erosion starting during the Holocene *(Fig. 5.3)*.

Three major neotectonic depressions or sub-basins with a decisive role in this geological evolution are located in the study area: the Körös Basin, the Szarvas Basin and the outlet of the River Sajó (Sümeghy 1944; Rónai 1985) *(Fig. 5.4)*. Thanks to the unique geological setting and the differential neotectonic movement of the sub-basins, the coarser Upper Pleistocene and Holocene gravels and sands accumulated at a larger distance from the study area, at the interface of the foothills and lowlands (Nádor *et al.* 2003). Mainly fine-grained deposits of clays and silts accumulated in the inner parts, thus in the valley of the Berettyó as well.

According to the geomorphological analysis, the channel of the Kiri-tó is a relatively ancient one, which must have formed as early as the Pleistocene, possibly during the Würmian period *(Fig. 5.5)*. It must have formed as part of an ancient fluvial channel system running down from the NE to the SW, a little bit more to the south than the present-day valley of the Berettyó. This river must have discharged into the small neotectonic depression located in the surroundings of Szarvas and observable even today (Rónai 1985). The emergence of the cutoff channel of the Kiri-tó, and the birth of the present-day fluvial system of the Berettyó must have occurred during

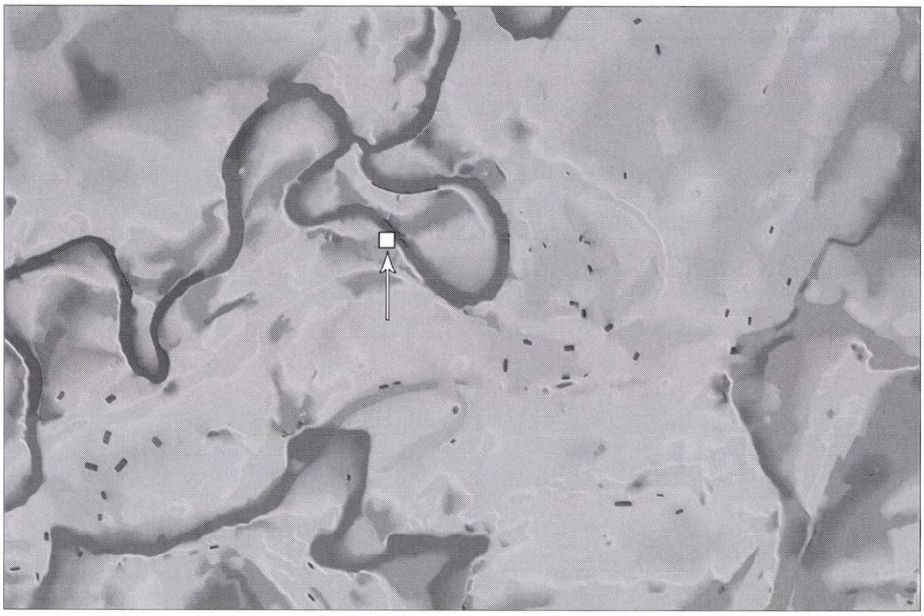


Fig. 5.3. The geomorphological formations depicted on a digital field map (Timár 2003). Ecsegfalva 23 is shown by a square and an arrow

the end of the Würmian and the Holocene. During this time, the river cut itself into the older alluvia at a depth of 3–2 m as a result of the subsidence of the foreland (the Szarvas Basin), forming an incised valley. The outcome of geomorphological forms are clearly observable on the digital elevation model (DEM) of the area *(Fig. 5.3)* (Timár 2003).

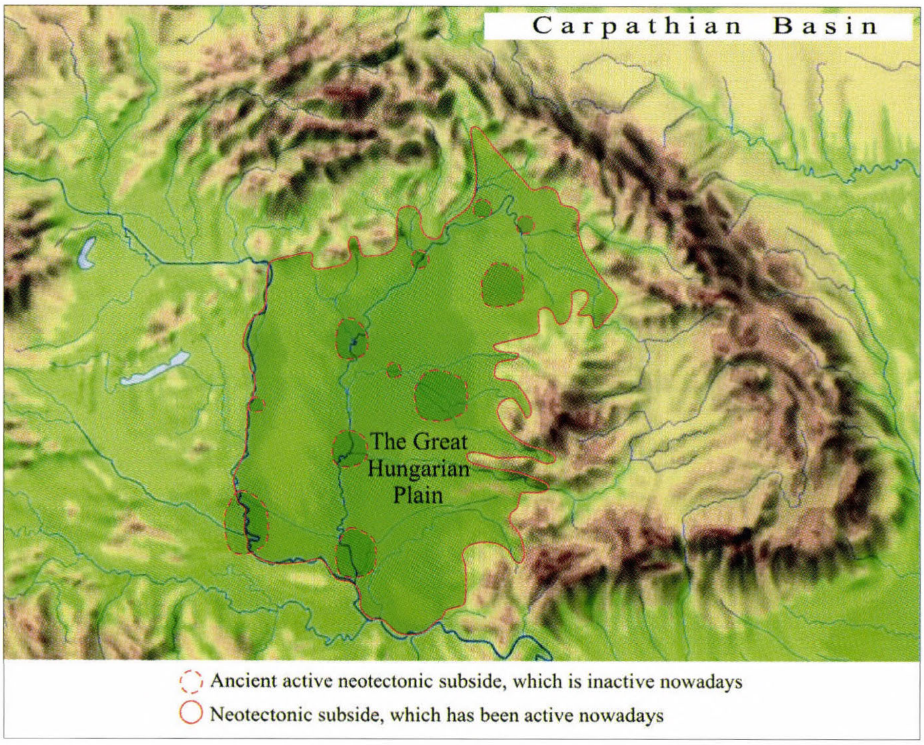


Fig. 5.4. The sub-basins of the Great Hungarian Plain

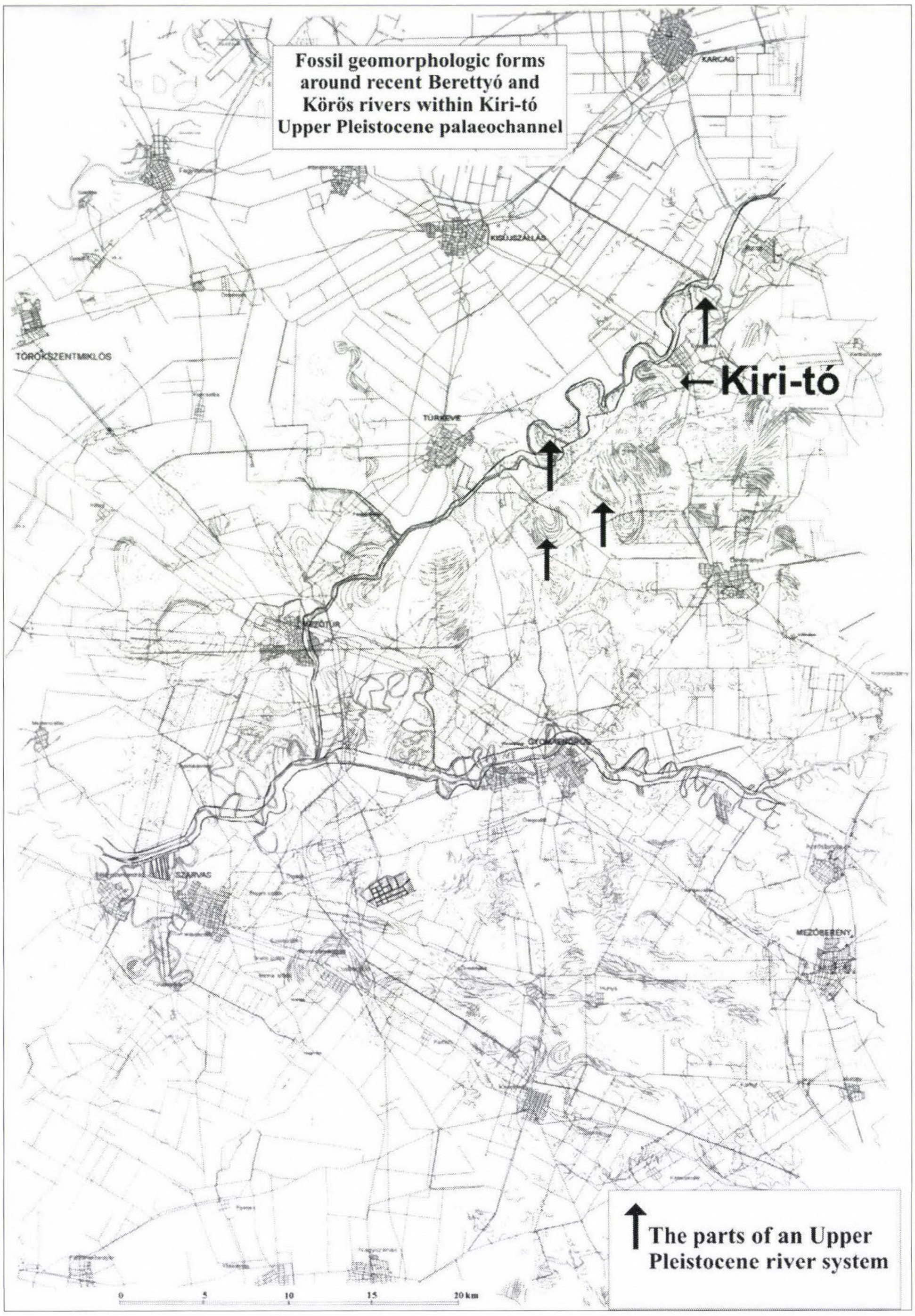


Fig. 5.5. Palaeochannel systems around the Kiri-tó (Nádor *et al.* 2003)

The location and selection of the coring sites

The infilled cut-off channel of the Kiri-tó forms a sedimentary basin linked to archaeological sites. It has been investigated from an environmental historical aspect as well. This minor sedimentary depression preserves layers from which the once prevailing environmental conditions and the history of its development can be elucidated via the application of various sedimentological, geochemical, chronological and paleoecological (analysis of macro- and microfossils, pollens, charcoal, diatoms, phytoliths and molluscs) tools (Mackereth 1966; Birks and Birks 1980). These sedimentary basins tend to preserve not only so-called autochtonous deposits accumulated on site, but allochtonous ones as well, transported into the basin from larger distances. Thus, we can identify traces of human-induced soil erosion horizons and vegetation changes in the deposited layers (Edwards 1979; 1982; 1991). The sedimentary basin is best suited for the investigations of the relationship between people and environment throughout the course of history, when relevant archaeological sites are located adjacent to the lacustrine system. No such analysis of Neolithic sites has been published so far from Hungary. However, the results of such work have been presented on a Bronze Age site (Sümegi *et al.* 1998; Sümegi 2000a). The major goal of each and every analyis was to shed light on the surrounding environmental conditions of the oxbow lake prevailing before the appearance of agricultural production, and during the time of the Early (Körös culture) and Middle Neolithic (AVK: Linear Pottery culture of the Great Hungarian Plain), and to understand the effects these human communities had on the environment.

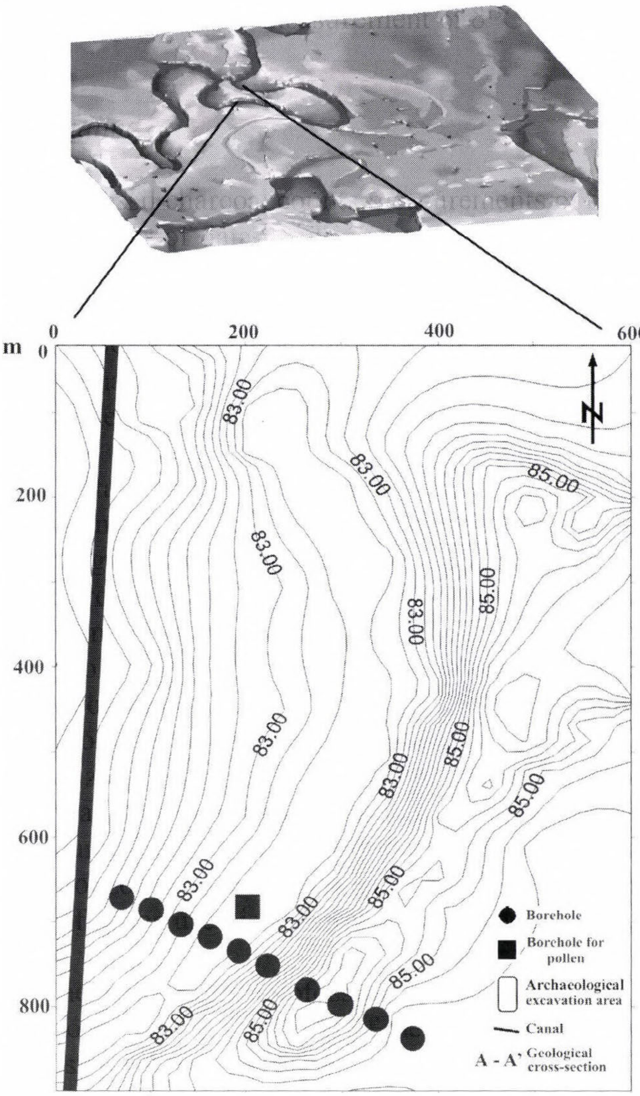


Fig. 5.6. The position of the A-A' geological cross-section of Kiri-tó

Two geological cross-sections were recorded in the study area (*Figs 5.1* and *5.6–9*). The northern section runs from the centre of the channel through site Ecsegfalva 18 of the AVK group *(Figs 5.6–7)*, while the southern section was taken across the channel at site Ecsegfalva 23 of the Körös culture *(Figs 5.8–9)*. These cross-sections were used to determine the coring sites for taking undisturbed samples for pollen, phytolith, malacological and radiocarbon analysis from the channel. An auger was used for the geological mapping (32 boreholes), while undisturbed samples for pollen, phytolith and radiocarbon analysis were taken by a Russian corer (six boreholes) (Bell and Walker 1992). Two further profiles were dug by hand for taking samples for malacological analysis.

No samples were taken from the bedrock due to the high carbonate and iron content as well as the compaction of the deposits. Several augers and Russian and Cobra bitheads were damaged during the coring process. Despite the fact that the bedrock was not reached, the layers deposited during the past 11–12,000 years and which are important for archaeological investigations have been sampled. According to the results gained, the channel must have formed during the Pleistocene, possibly in the early phase of the Würmian period.

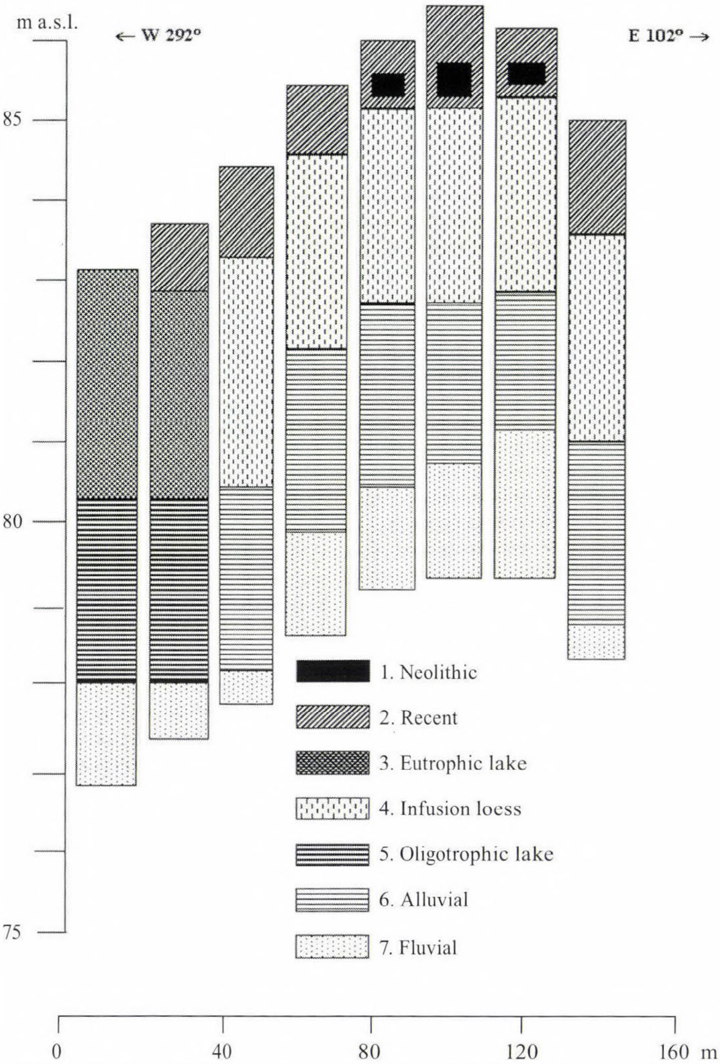


Fig. 5.7. The geological cross-section A-A' of the Kiri-tó

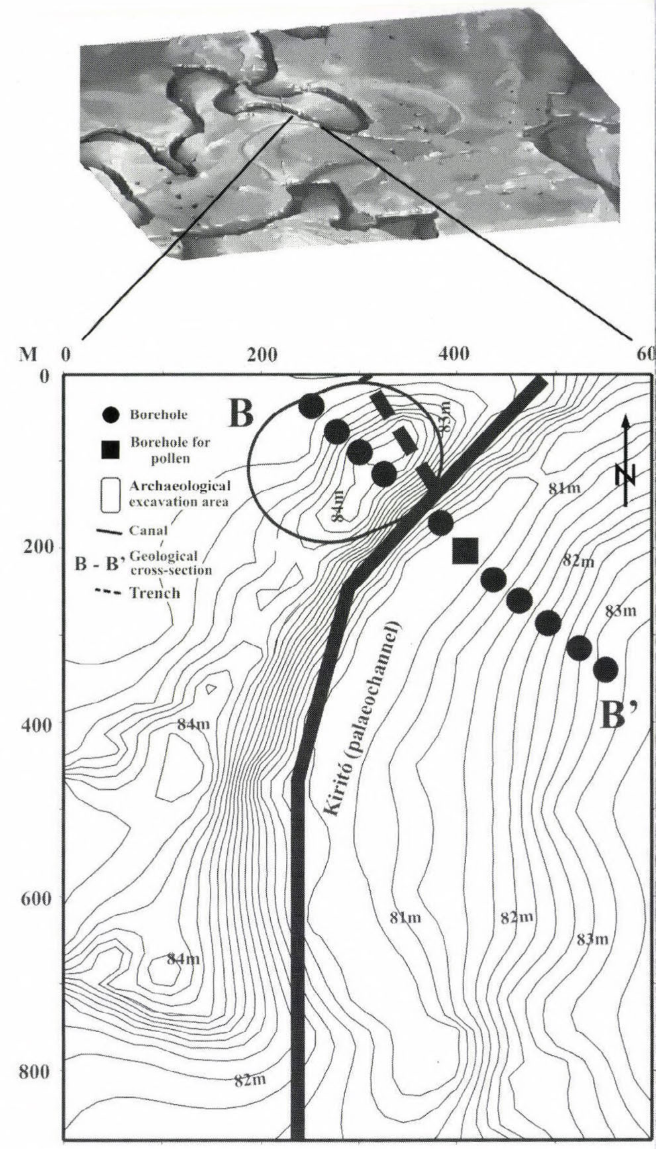
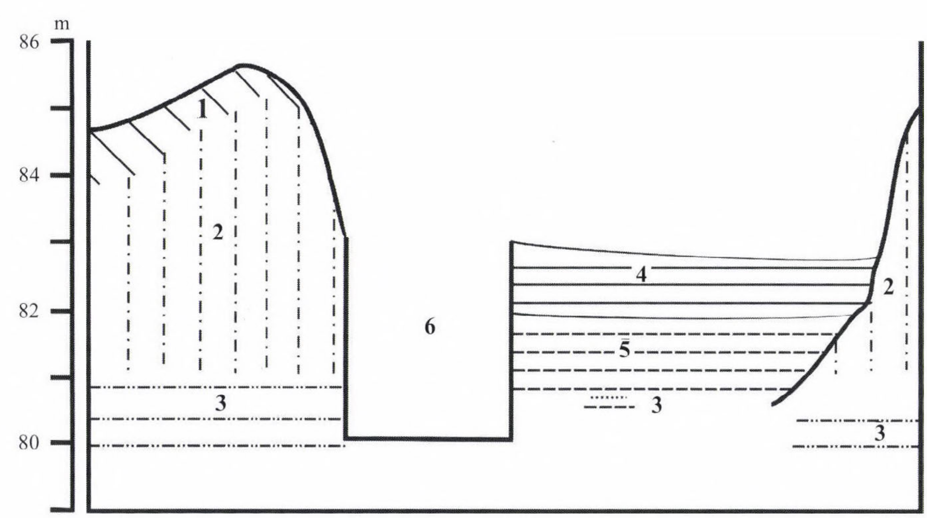


Fig. 5.8. The position of the B-B' geological cross-section of Kiri-tó



1. Soit within Neolithic finds
2. Infusion (Alluvial) loess
3. Fluvial sandy silt
4. Holocene organic rich silty clay
5. Pleistocene silty layers with low organic content
6. A river regulation channel

Fig. 5.9. The geological cross-section B-B' of the Kiri-tó

Lithological analysis

All samples taken from the undisturbed cores and the geological profiles created for the sampling of the malacofauna have been analysed for grain-size composition (hydrometry: Molnár 1981), and organic and carbonate content (Dean 1974). Furthermore, completely new approaches have been introduced during the sedimentological analysis with regard to pollen preservation.

These corings in the channel of the Kiri-tó were complemented by the analysis of the sediments at and within the surroundings of the archaeological sites by boring over a 5 by 5 m grid to an average depth of 2 m (196 boreholes). Plough horizons, the soil infills made during the industrial age to prevent alkalisation, as well as the disturbed soil and undisturbed hidromorphic woodland (which developed under gallery forest) and black soil horizons of the Neolithic and the bedrock horizons, were identified within these boreholes along with their morphological positions *(Fig. 5.10)*. Then by separating human-induced infilling in the area and removing the culture layers, which formed as a result of human activities of the individual periods (for example, the Sarmatian earthwork, and medieval and modern historical trenches) from the digital model, and the restoration of the original soil horizon, which was eroded later on, the original geomorphological conditions have been reconstructed for the Neolithic *(Fig. 5.11)*.

Radiocarbon analysis

A significant amount of shell material of the species *Planorbarius corneus* and *Unio pictorum* available from a depth of 1.6–1.5 m enabled the radiocarbon analysis of an open mass sample. The preparation of the shells necessary for the analysis was carried out in accordance with Hertelendi *et al.* (1992).

The results of the sedimentological analyses

The layers from the base of the borehole towards the surface correspond to the deposits of a gradually silting-up oxbow lake *(Fig. 5.12)*. The lowermost horizon between the depths of 2.2–2.0 m is made up of brownish-yellow, carbonate-rich silts with a minimal organic and clay content. This sediment type corresponds to the aeolian minerorganic deposits accumulating in a cold-water, oligotrophic lake (Oldfield 1978), which is highly characteristic of the loose-bound sediments which accumulated in Hungarian ponds and oxbow lakes during the Late Glacial (Willis *et al.* 1995; Sümegi 1996; 1998; 1999a; 2004; Sümegi *et al.* 1999).

There is a sudden increase in the clay and organic content in the overlying horizon between 2.0–1.6 m, accompanied by a significant drop in the carbonate content and the deposition of organic-rich, yellowish-brown clayey silts. This sedimentary facies is closely linked to the environmental changes which occurred at the end of the Pleistocene and the beginning of the Holocene as a result of the global warming-induced intense weathering and the emergence of a new type of vegetation cover in Hungary (Willis *et al.* 1995; 1997; Sümegi 1998; 1999a; Sümegi *et al.* 1999; Juhász 2002; Magyari *et al.* 2002). The Pleistocene oligotrophic lake gradually turned into a mesotrophic lacustrine system via eutrophisation at the start of the Holocene. Another significant increase in the clay and organic content in the near-surface layers must be related to the emergence of agricultural production in the area at the end of the Early Holocene, resulting in a disturbance of the original vegetation and the erosion of the clay and organic fraction of the soils, which had developed in the surroundings of the Kiri-tó.

At a depth of 1.6–0.4 m, right above the zone of soil erosion, a blackish-brown, organic-rich silty clay layer has been identified corresponding to eutrophic lacustrine deposits. The signifi-

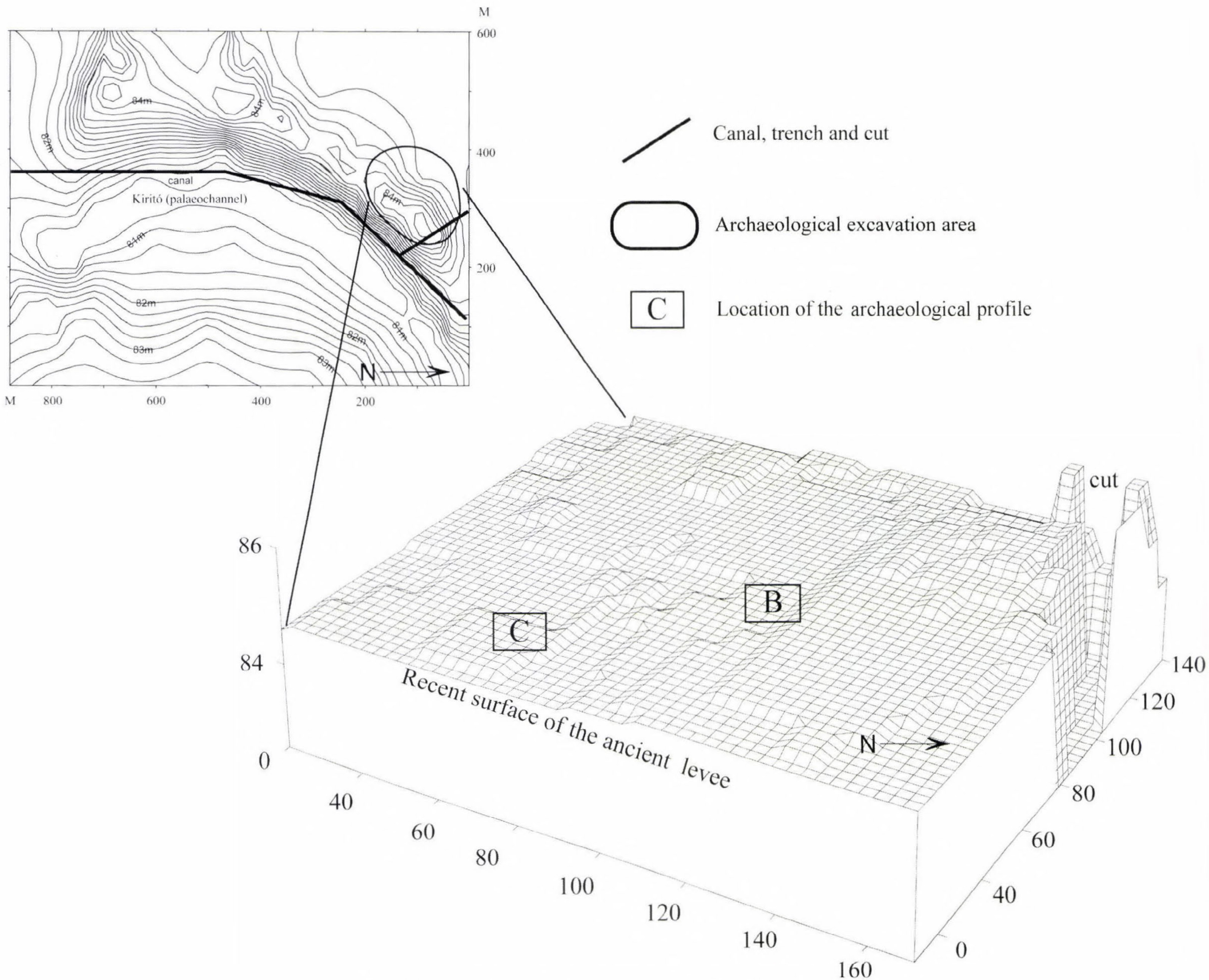


Fig. 5.10. Recent surface around the Körös site of Ecsegfalva 23

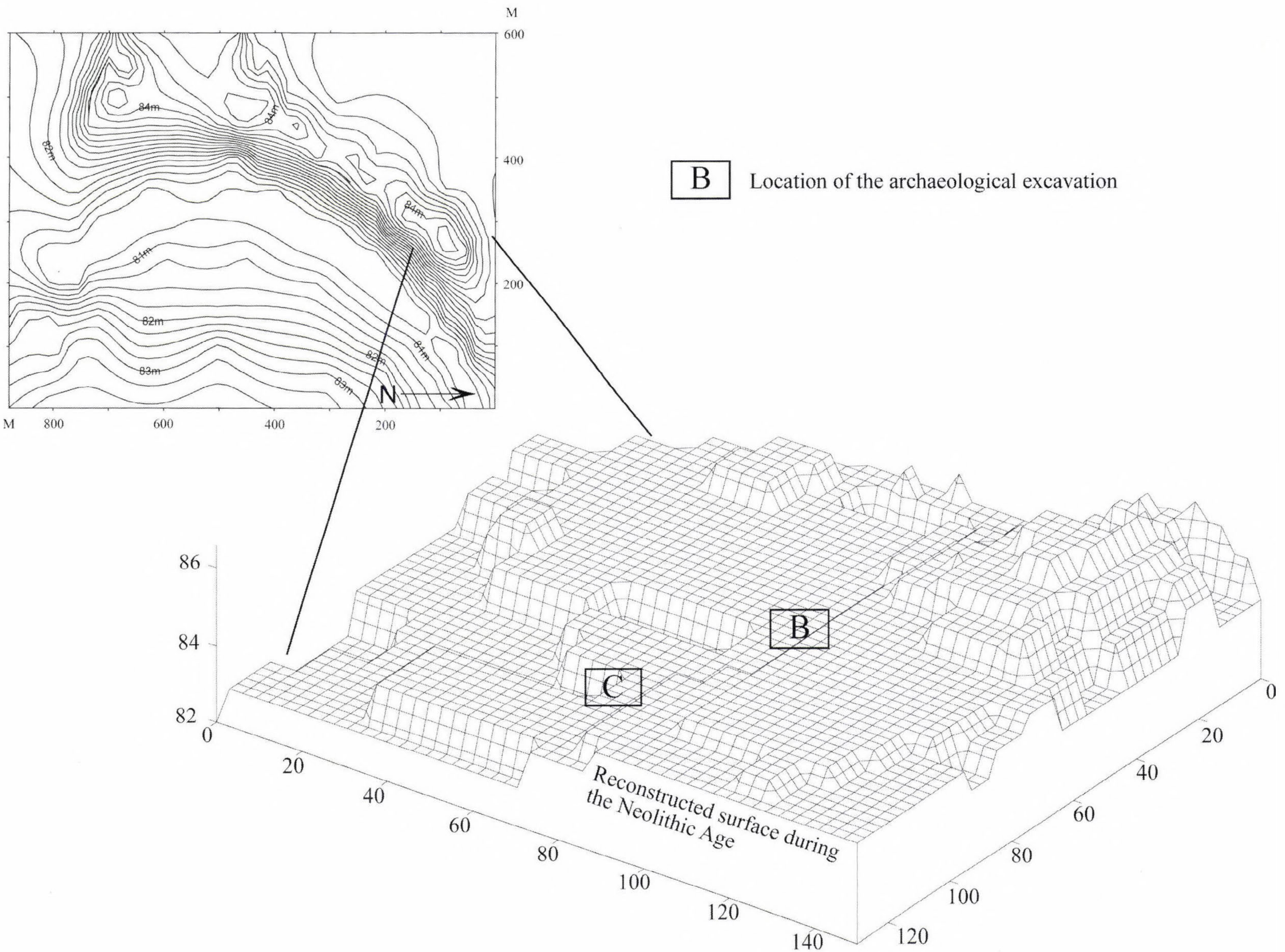


Fig. 5.11. Neolithic Age surface around the Körös site at Ecsegfalva 23

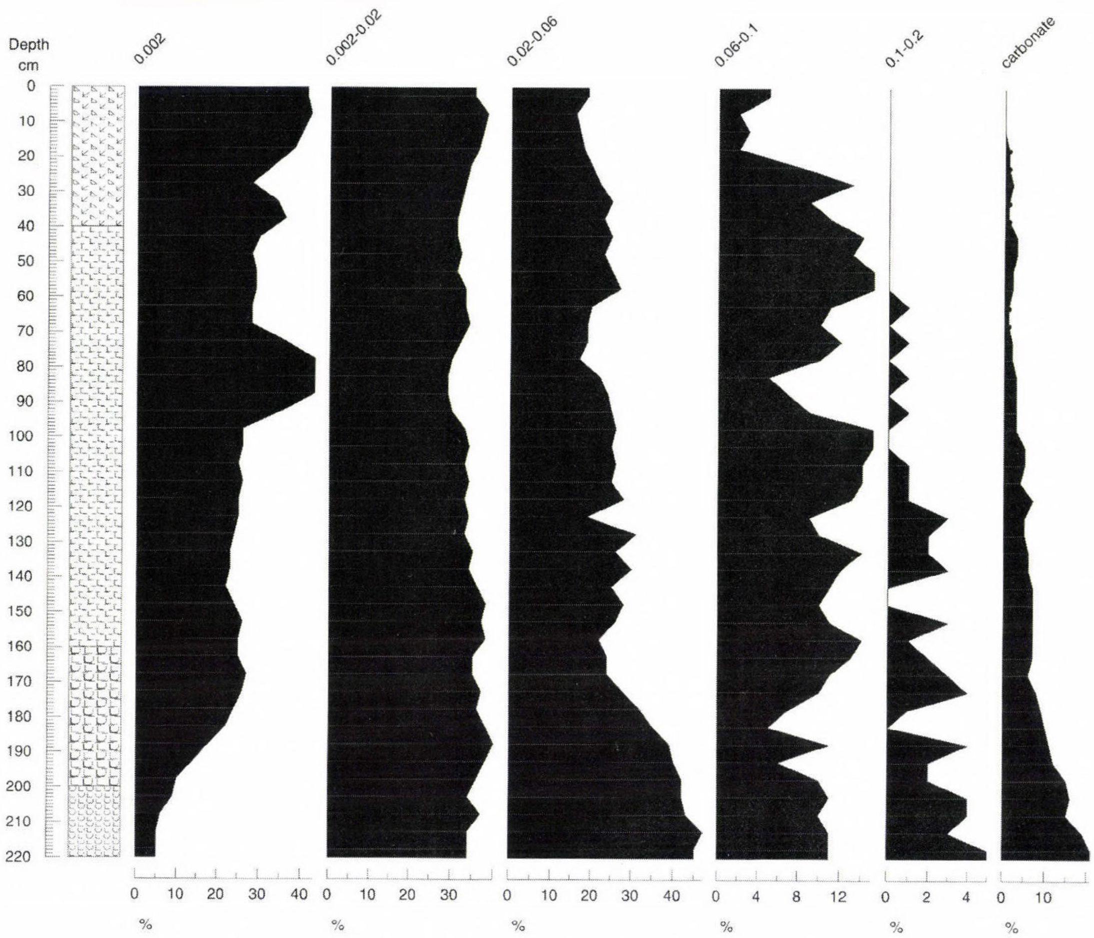


Fig. 5.12. Sedimentological results of the Kiri-tó geological profile at Ecsegfalva

cant amount of brownish-red limonite and goethite spots in the layers must indicate the former fluctuations of the groundwater level, and the intensive falls and rises in the water level within the lacustrine system. According to the transformations identified in the deposits, the silting-up of the channel and the erosion of the soils in the surrounding areas must have accelerated during this time, resulting in a rapid eutrophisation of the Early Holocene lake and the emergence of an organic-rich eutrophic lacustrine system with highly fluctuating water levels during the second half of the Holocene.

From a depth of 0.4 m up to the surface, we have come across a layer of blackish-brown peaty clay embedding reed (*Phragmites*), bulrush (*Typha*), and sedge (*Carex*) remains. According to the composition of the deposits, the lacustrine system must have turned into a periodically drying-out marshland during this time.

As can be seen on the cross-sections *(Figs 5.8–9),* the riverbanks, with a bedrock of sands and clayey silts, are uniformly covered by silt- and carbonate-rich Pleistocene infusion loess layers. These loess horizons must have formed from aeolian dust deposited under humid conditions in wet areas (Földvári 1958; Pécsi 1993) and are stratigraphically closely linked to the carbonate- and silt-rich oligotrophic lacustrine deposits of the Kiri-tó channel. Thus the silt or carbonate, which accumulated in the lacustrine basin, or at least a part of it, must have derived from the syngenetic inwash of these infusion loess layers.

The facies of the Holocene organic-rich lacustrine deposits on the other hand seems to correspond lithostratigraphically to the soil layers, which formed on top of the infusion loess layers.

Consequently, the deposition of the Holocene lacustrine sediments and the formation of these soils must have been isochronous or coeval. According to the results of the radiocarbon analysis (from the shells of *Planorbarius corneus* sampled between 1.6–1.5 m: 7400±70 BP, 6362–6270 cal BC, and from the hypostracum layers of *Unio pictorum*: 7010±100 BP, 5979–5798 cal BC; and see the following chapter), the section between 1.6–1.5 m within the channel of the Kiri-tó must correspond to the period of the Early Neolithic. As the grain-size composition revealed, there is a slight increase in the clay and organic content of the deposits within this part of the profile, most likely as a result of the emergence of agricultural production in the area, and the accompanying transformation of the vegetation, the creation of arable and pasture, as well as the establishment of permanent settlements and continuously trodden trails. All these human influences must have enhanced the acceleration of soil erosion in the area and the eutrophisation of the Early Holocene mesotrophic lake. According to the composition of the sediments, a mesotrophic lake with waters of an average depth of 1.5 m must have formed during this time within the channel of the Kiri-tó.

Similar changes could be observed in all boreholes in the channel. However, the thickness of the deposits was different in the centre compared to the marginal littoral areas.

The effects of river regulations

In order to get an understanding of the original hydrological conditions and drainage patterns prevailing in the area of the Great Hungarian Plain, the hydrogeological systems present before the nineteenth-century river regulations should somehow first be understood, along with other minor water control works affecting the natural system of waters within the Carpathian Basin.

The Romans were the first to implement comprehensive river regulations within the Carpathian Basin with the establishment of the so-called Principal channel in the province of former Pannonia, today Transdanubia, creating a hydrological link between the Mura and Zala rivers, and draining the surrounding marshlands. Furthermore, the predecessor of today's Sió channel was used for the regulation of the water level within Lake Balaton (Szalai 1985).

During medieval and modern times, the regulation of rivers and the drainage of wetland areas became gradually more and more desirable and were thus frequently advocated. Initially, only earthworks of local importance were erected, but successively more water courses were constrained between artificial levées from the eighteenth century onwards. The regulation of the watercourses of the Vág, Lajta, Rába, Sárvíz, Sió and Kapos along with the certain parts of the Danube was initiated, sometimes regardless of the objections of the local population.

On the other hand, the construction of mill-dams and entrenchments surrounding fortresses contributed to the expansion of wetland areas. The site of the breach in the natural levée called the Mirhó crevasse-splay ('Mirhó-fok'), which served as a hydrological link towards the Middle Tisza was cut off in 1787. Formerly, floodwaters from the Tisza managed to reach as far as the area of the Nagy-Sárrét via this crevasse-splay, and its elimination rendered a major part of the Nagykunság north of the River Berettyó flood-free. Regulation works on the River Tisza were initiated during the second half of the nineteenth century, the Age of Hungarian Reformism, based on the plans and concepts of Pál Vásárhelyi, enjoying both intellectual and material support from István Széchenyi. The first sod cut on the 27th August 1847 at the village of Tiszadob marked the start of one of the most significant landscape transformations in Europe, lasting with minor intermissions until 1905. 94 bends were cut off from the main channel from the village of Tiszaújlak down to the mouth of the river, taking away a section of about 453 km from the full river length, and reducing the area of the floodplain to one tenth of its original size *(Fig. 5.13)*. For the same ends, tributaries were also regulated. The twentieth century marked the establishment of dams and hydro-electric powerplants. The total length of primary dams along the rivers today

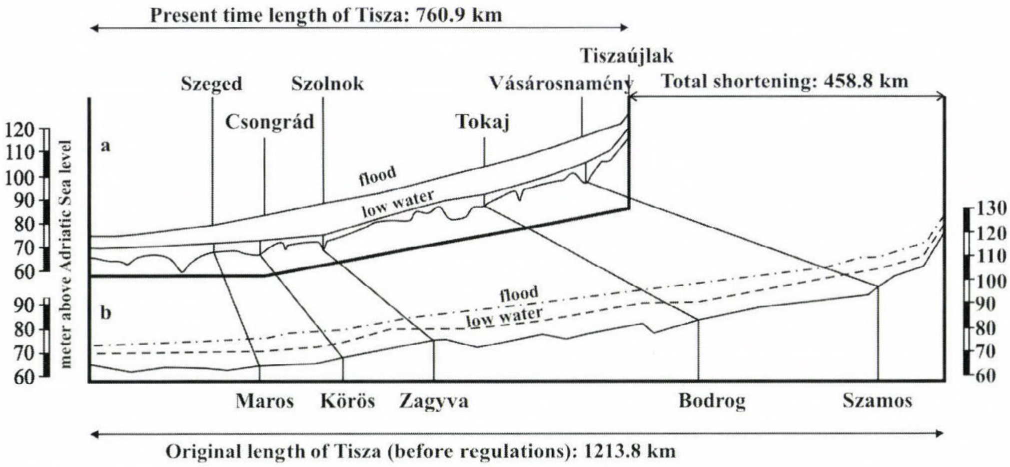


Fig. 5.13. Changes in the length of the River Tisza following the water-regulations (1847–1905) (modified)

in Hungary equals to 4.211 km, and the former floodplain areas of 21,251 km^2 have been reduced to a size of 700 km^2 (Hamar 2000).

The negative, undesired consequences of the river regulation works were emphasised by László Dapsy as early as 1869. His achievement was to acknowledge the differences between Hungary and other countries like Germany, compiling a list of advantages and disadvantages of the outcome of the regulation works. Although some of his reasoning is questionable, his work is outstanding and fundamental (Dapsy 1869). The task of the generations of the twenty-first century is to establish a water management system, taking into consideration the erroneous steps made in the past as well, which not only provides safety from floods to those living along the watercourses, but is also in accordance with the natural processes and treasures prevailing in the area.

Floods before and after the river regulations

The large-scale river regulations initiated in the nineteenth century have fundamentally altered the natural evolution of Hungarian rivers, creating active floodplains which represent only a minor fraction of the former extensive floodplain areas. The cutoffs increased the velocity of the streams, bringing about a larger rate of incision of the original riverbed. The difference between the high and low waters of floods has also increased. Without any accurate data on the water levels at hand, one can only give an estimate on the magnitude of these changes. Data on four major flood events from the profile of the city of Szeged are known for the River Tisza preceding the river regulations, with highest waters of approximately 620 cm above normal levels in all cases.

These are generally 2.5–3 m higher today. The highest waters during floods were recorded at Szeged to be 960 cm and 929 cm in 1970 and 2000 respectively. The low water level has also been greatly reduced because of the deepening of the active riverbed. These changes are around 2.5 m at Szeged. The magnitude of change is different not only for the rivers, but the individual reaches of a single watercourse as well. The increased stream velocity and incision created extreme stream flows. The highest water measured at Szolnok on 18th April 2000 was 1041 cm. In just under two months, the water level dropped to –134 cm (17/06/2000), reaching an absolute minimum of –230 cm at the end of August. The water level remained extremely low in the channel till the end of that year. These fluctuations in the water level during the year of 2000 are by no means ordinary. However, no such differences could have been observed between the high and low waters preceding the river regulations. At the same time, the floodwaters extended over larger areas, and the floods tended to last longer as well. However, these somehow all contributed to the creation of a more balanced water regime *(Fig. 5.14).*

Even fewer data are available regarding the high and low waters of the tributaries of River Tisza, and thus the rate of alterations can only be estimated. Finding an accurate value for the River Berettyó is especially hard, as the present-day watercourse is totally different from the one that existed before river regulations. The lower reach has completely lost its connection to the upper reach of the river, presently acting as a drainage channel of inland waters under the name Hortobágy-Berettyó *(Figs 5.15–19).*

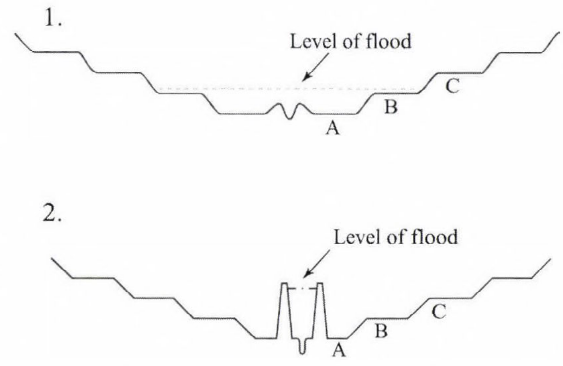


Fig. 5.14. The cross-section of the channel preceding and following the river regulations

However, those elevated regions which were only a couple of metres high, referred to as 'laponyag' in Hungarian, and which must have served as sites of human settlement, were either totally free of floods or affected only by the most extreme flood waters. These island-like segments were the cores of the former medieval and present-day settlements (Túrkeve, Szerep), and sometimes were inhabited during ancient times as well. The Pleistocene lag-surface near the area of Kiri-tó can be regarded as a good example of these.

Besides the regulation of the river, the former marshland areas were also drained along with the accumulated inland waters on the protected side. This contributed to a significant drop in groundwater level.

The Berettyó and the Nagy-Sárrét following the river regulations

The area of the Nagy-Sárrét is located between the settlements of Bucsa, Bakonszeg, Füzesgyarmat and Dévaványa along the Ó-Berettyó. Only the name of this minor landscape reminds us today that once significant amounts of water covered these areas. Low-quality arables, alkaline steppes and a large number of smaller-larger channels are the prevalent forms of the landscape today. All these alterations happened during the past 150–200 years as a result of human activities and interventions aimed at draining the inland waters in every possible way *(Fig. 5.19).*

The density and abundance of the former aquatic flora and fauna are known from surveys made before river regulations (Dóka 1997). The hydrographer Mátyás Huszár carried out an extensive mapping of the important marshlands along the rivers of the Körös and the Berettyó in 1825. The final results of the survey yielded a total marshland area of 1927 km^2 (as a comparison Lake Balaton today covers 595 km^2).

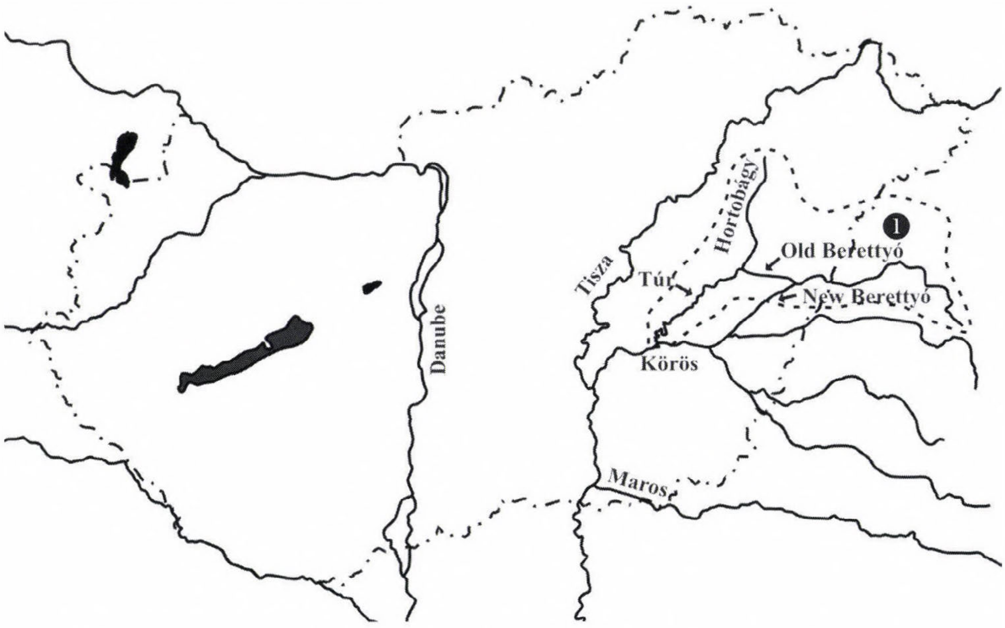
The most important marshlands were as follows: Komádi Sárrét (Kis-Sárrét): 345 km^2; Fási rét: 129 km^2; Péli and Gyulavári rét: 115 km^2; Gyánti rét: 57 km^2; Nagy Posár (Nagy-Körös, along the Berettyó): 86 km^2; and Berettyó Sárrét (Nagy-Sárrét): 671 km^2. No wonder the forename of this latter marshland is 'Nagy' or 'Great' in English. This low-lying depression drained not only the waters of the Berettyó, but other rivers as well. The Kakat creek used to carry waters from the River Tisza into this depression through the Mirhó crevasse-splay of Abádszalók. Furthermore, the minor waterflows of the Hortobágy and the Kék-Kálló also drained into this area. The Kis-Körös, on the other hand, transported waters from the Sebes-Körös into the River Berettyó. The former inhabitants of the landscape, who had a good knowledge of the water courses, could tell the origin of the waters reaching the area of the Sárrét by their colour alone. The waters originating from the Körös were greenish, those from the Berettyó were brownish, those of the Kálló were bluish, and those from the Tisza were yellowish or 'blonde' (Szűcs 1992).

The most influential stream in the evolution of the Nagy-Sárrét, however, was the Berettyó. The name Berettyó comes from an ancient Hungarian word denoting a river with lush gallery forests (Rakonczay 1987). The lower reach of the river flowing out of the Sárrét is marked under the name Túr in medieval maps and charters, meaning auroch. This designation is still preserved in the name of some settlements located along the River Berettyó, like Túrkeve and Mezőtúr *(Fig. 5.15).*

The river derives from the Meszes Hill in the Transylvanian Mid-Mountains (at a height of 582 m) with a watershed area of 64,7465 ha. The watershed area enjoys a precipitation over 900 mm in the area of the Szilágyság from the Réz Hill (Transylvania). However, the average rainfall on the Great Hungarian Plain and at the interface of the lowland and foothill areas is around 600 mm only (Lászlóffy 1982). The rainfall peak is in June with the lowest rates in January and February.

The total average annual rainfall is rather low in the area of the Nagy-Sárrét with values between 530–550 mm. However, these can be even lower in the western parts. The average rainfall during the growth season is around 310–320 mm. The aridity index is between 1.28–1.33. This is a rather arid region. This aridity has been somewhat moderated by the waters of the Keleti main channel constructed during the second half of the twentieth century. The unfavourable soils and the strong alkalisation make the situation even worse in the region. A significant amelioration is necessary for the utilization of the lands in agricultural production (Marosi and Somogyi 1990).

The region of the Sárrét, just like the majority of the Great Hungarian Plain, is not totally smooth, but is studded with smaller or bigger morphological forms. The near-surface deposits are exclusively of Pleistocene Age. Organic-rich clayey deposits of Holocene Age are predominant along the River Berettyó with elevated Pleistocene infusional loess-covered ridges. People used to settle on these island-like elevated surfaces during historical times. Their importance is well represented by the town of Biharnagybajom, which was an agricultural centre in the Middle Ages. The low-lying meadows and pastures offered either food or very often protection for their inhabitants during the course of history.



1 Catchment Area of Old Berettyó   Túr = Medieval name of a part of recent Berettyó river

Fig. 5.15. Changes in the length of the Berettyó

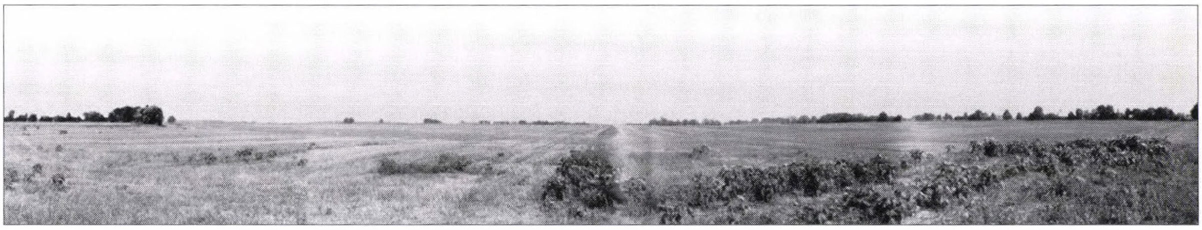


Fig. 5.16. The Berettyó dam

Fig. 5.17. High water level in Hortobágy-Berettyó next to the area of the Kiri-tó

Fig. 5.18. Some remains of the natural vegetation within the regulated channel

Afterword: possible solutions for the present day

River regulations, initiating in the middle part of the nineteenth century in the area under study, brought about fundamental changes regarding landscape evolution. Human influences, though observable formerly as well in the area, were rather negligible compared to the changes implemented during the past 150 years. As a result of these anthropogenic effects, the formerly relatively wide floodplain ceased to exist, and the regions of the Sárrét were fully drained.

Future attempts at a reconstruction of the original landscape should be aimed primarily at eliminating these above mentioned changes in the area. The lower course of the Berettyó, located right next to the area of the Kiri-tó, has been regulated not by the application of the traditional cut-off of the former riverbed. Rather the original channel was preserved with a relatively wider active floodplain constrained between artificial levees. Yet the original size of the floodplain has been significantly reduced this way. For example, the formerly flood-influenced areas of the Kóré-zug and the channel of the Kiri-tó got on to the inactive protected side of floodplain. Several gates were constructed within the channel of the Kiri-tó. The watercourse of the Berettyó was directed right into the River Sebes-Körös through an artifical bed, preventing it from running

Fig. 5.19. A drained and ploughed former flat at the edge of Ecsegfalva

across the area of the Nagy-Sárrét. The reach downstream of the village of Bakonszeg was linked to the Hortobágy creek, and the former outlet into the Körös at Túrtő has been placed under control with the help of gates as well. In this way the water regime of the newly emerged Hortobágy-Berettyó main channel system has become fully administrable.

In order to preserve the flora and fauna of the surrounding protected areas, the effects of this artificial system should be somewhat moderated, to emphasise the importance of natural processes in the area. Within the framework of international co-operations, a special emphasis is laid on the introduction of traditional and sustainable production forms and methods. These principles were first conceptualized on the 1992 UN Convention on the Environment and Development in Rio de Janeiro. There, the maintenance of sustainable growth, the protection of the biodiversity, as well as the reduction of green-house gases has been advocated. The 1997 XLI bill on Hungarian industrial and sport fishing was aimed at the introduction of new methods and tools, which are respecting the protected treasures of the country, and are implemented in accordance with the needs of conservation. The management of the Körös-Maros National Park is intending to restore the former original conditions of aquatic life in a part of the Nagy-Sárrét as well in the near future *(Fig. 4.19).*

It would be highly desirable to consider the traditional medieval floodplain management methods for the reconstruction of the former drainage pattern and aquatic environments in the area of the Kiri-tó as a possible solution for the expansion of the floodplain area, with the reestablishment of aquatic, marshland habitats and orchards within the area of the gallery forests. This would create new workplaces for the local workforce as well by the introduction of a sustainable form of agricultural production, besides the conservation of the close-to-natural conditions in the area. The re-establishment of this system of crevasse splays and floodplain management based on ancient principles would also enable us to re-evaluate the effects of floods on the landscape within the Carpathian Basin from a brand new and totally different point of view, enhancing the exploitation of the natural resources of soils and waters more efficiently in a nature-friendly way.

Chapter 6

THE IMPACT OF THE EARLY NEOLITHIC KÖRÖS CULTURE ON THE LANDSCAPE: EVIDENCE FROM PALAEOECOLOGICAL INVESTIGATIONS OF THE KIRI-TÓ

Katherine J. Willis

Introduction

The influence of the early farmers in the creation of the 'openness' of the present day south-eastern Hungarian landscape (which encompasses the Great Hungarian Plain), has long been a subject of interest. At least three suggestions have been put forward as to how and when this landscape was created and these are as follows:

1. That this part of Europe was never extensively wooded during the Holocene and its openness is a consequence of the relatively dry continental climate combined with cold winters (Frenzel 1992);
2. That the south-eastern Hungarian landscape was wooded in the early postglacial, similar to other regions in north-eastern Hungary and Romania (e.g. Willis *et al.* 1995; Willis *et al.* 1997; Willis *et al.* 1998; Magyari 2002; Björkman *et al.* 2003; Feurdean 2005) but was extensively cleared by the early farmers from approximately 6000 BP. Following this 'initial' clearance the landscape was then either too vulnerable to ever fully recover or continuous activity by subsequent groups resulted in the landscape remaining 'open';
3. That the 'openness' is a relatively recent phenomenon and as a consequent of clearance in the historical period resulting from the utilisation of more refined agricultural technology.

The postglacial vegetation dynamics of south-eastern Hungary are therefore particularly relevant to the Ecsegfalva project since there are at least two very different landscapes in which to view the occupation of the site (i.e. wooded or open). There is also the question as to whether the Körös culture and its associated early farming technologies were responsible for clearance and creation of the present day landscape.

Assessing the impact of the first farmers upon the south-eastern Hungarian landscape has always been problematical. In particular, the dry nature of much of this landscape has meant that finding suitably waterlogged sediments in close proximity to detailed archaeological excavations has been difficult. The location of an ox-bow lake, Lake Kiri-tó, containing organic, waterlogged sediments approximately 50 m from Ecsegfalva 23 therefore provides an important opportunity to reconstruct the wider landscape around the occupation site and assess the impact that the activities of the Körös culture had on this landscape.

This chapter describes results from a detailed palaeoecological study carried out on a sedimentary sequence collected from Lake Kiri-tó and describes the analyses of fossil pollen, microfossil charcoal and nitrogen and carbon analysis ($\delta^{15}N$, $\delta^{13}C$, C/N and total organic nitrogen) from the Kiri-tó sediments. The principal aim of this palaeoecological study was to reconstruct the landscape before, during and after occupation of the Ecsegfalva site. Specific research questions related to the time of the Körös occupation and raised by other on- and off-site investigations described in this volume were also addressed. These included for example why the settlement structures of the Körös culture were built out of reeds (Carneiro and Mateiciucová, chapter 13). Is this indicative of a lack of locally available wood? On-site archaeobotanical and faunal evidence provides a compelling case for animal husbandry and the growing of crops (Bartosiewicz, chapter 14, and Bogaard *et al.*, chapter 23), but what was the scale of these activities? Did the Körös culture people carry out widespread clearance of a wooded landscape? Or was the landscape already open and therefore readily available for the growing of crops and animal husbandry? If clearance was undertaken, did this involve widespread burning of the landscape? Also associated with animal husbandry and agriculture is the question of whether these activities had an impact on the soils. Is it possible to detect, for example, changes to the local soil chemistry with the addition of nitrogen either intentionally (through manuring) or unintentionally (dung)? Through addressing these questions, this study aimed to provide an important environmental framework in which to view the on-site investigations of Ecsegfalva and the relationship of the people of the Körös culture with their landscape.

Study site and spatial representation of the palaeoecological records

The sedimentary sequence for the palaeoecological investigations was collected from the Kiri-tó, approximately 500 m north-west of the main excavation site (Ecsegfalva 23). The Kiri-tó is an ox-bow lake comprising a long, thin curved cut-off channel some 3 km from west to east and of variable width: up to 200 m and more in places, though narrower in others (*Fig. 5.1*; chapter 5). The ox-bow lake developed following a cut-off sometime in the Late Pleistocene (see Sümegi and Molnár, chapter 5). Dating of the exact time when this occurred is difficult but it certainly predates the sedimentary sequence; there is no evidence of a reduction in pollen concentration, or an increase in reworked pollen material and/or inorganic material in the sedimentary sequence, all of which would be indicative of a transition from riverine to lake conditions. Riverine transport of material into the basin is therefore unlikely and the assumption is made that the palaeoecological records contained within the Kiri-tó sequence have been transported and incorporated into the sediments by other mechanisms (see also chapter 5).

Previous work has indicated that the spatial representation of the palaeoecological records varies according to the proxy being measured and the mechanism by which they are transported into basin (for a review see Smol *et al.* 2001). In this study the spatial scale represented by three records need to be considered; the pollen record, the microfossil charcoal record and the isotopic record ($\delta^{15}N$ and TON).

Spatial representation of the pollen record

Studies indicate that in a temperate forested landscape there are four main source areas for pollen entering a lake basin: pollen from local vegetation (within a 20 m radius of the lake basin); extra-local vegetation (within 20 m–2 km radius of the basin); regional vegetation (2 km–200 km of the lake basin); and extra-regional (beyond 200 km) (reviewed in Jackson 1994; Jackson and Lyford 1999). It was also noted that the relative contribution of the pollen from the different source areas would depend upon the dispersal mechanism and abundance of each pollen type and also size of lake basin (Jacobson and Bradshaw 1981; Prentice 1985; Sugita 1994); the larger the basin, and therefore the greater amount of open water relative to the edge of the basin, would result in the basin receiving a larger proportion from pollen rain in the atmosphere (and thus a regional source area) than the local vegetation growing around the edge of the basin. Further modelling of this relationship suggested that small basins (less than 100 m in diameter) would receive a pollen rain from a predominantly local source area and that as the diameter of the lake basin increased, so too would the contribution of pollen from an extra-local and regional source. The width of the Kiri-tó channel is seasonally varied, with GIS modelling indicating that when this landscape is flooded, as would probably have been the case during the time of the Körös occupation (see chapters 3–5), this whole cut-off channel would have resulted in an isolated lake up to 120 m in diameter (Gillings, chapter 3). It is therefore envisaged that the pollen record contained in the Kiri-tó sequence is recording both a local and extra-local vegetation record up to approximately 2 km away from the basin.

Spatial representation of the microfossil charcoal record

Charcoal contained in lake sedimentary sequences is an important fossil proxy for fire and has been used extensively as an indicator of past burning regimes. Charcoal particles contained within sedimentary sequences are another proxy that can have a regional, extralocal (nearby but not within the watershed) and local (within the watershed) spatial representation (Clark 1988; Whitlock and Larsen 2001). Two sizes of charcoal are routinely investigated in sedimentary records: microscopic charcoal (with size fractions < 100 µm and usually extracted and counted alongside the fossil pollen) and macroscopic charcoal (with size fractions > 100 µm usually quantified using petrographic thin sections or wet sieving) (Whitlock and Larsen 2001). In the examination of the sediments from Kiri-tó, microfossil charcoal particles were measured. Predictions based on Gaussian plume models suggest that particle size can be an important determinant of the spatial representation of the charcoal record (i.e. whether it represents local, extralocal or regional fires) and that particles < 100 µm tend to be carried much higher up into the plume from the fire. As a result they can be carried aloft to great heights and transported long distances and the presence of smaller particle sizes in a sedimentary record is can be representative of both a local and regional signal of burning. In addition to the size of the charcoal particles, studies have also indicated that similar to the pollen record, diameter of the lake basin (or the size of the watershed relative to the basin) can influence the proportion of charcoal received from a regional or local source (Whitlock and Millspaugh 1996). A small lake basin, such as Kiri-tó, for example, will receive a greater amount of its input from the environment immediately around the basin than a large lake. This is based on the assumption that a larger lake has a much greater surface area relative to the edge of the basin and will therefore receive more material from aerial transport. This will consequently magnify the input from the local environment in smaller basins relative to the input from regional sources; a relationship that has been demonstrated empirically in a number of studies.

Spatial representation of the nitrogen record

Measurement of the isotopic ratio of $^{14}N/^{15}N$ ($\delta^{15}N$), $^{12}C/^{13}C$ ($\delta^{13}C$) and also total organic nitrogen (TON) in lake sedimentary sequences has been previously demonstrated to be an important proxy for the identification of changes to nitrogen in the soils and vegetation around the basin and also in the lake basin itself (Talbot 2001). The nitrogen extracted from organic lake sediment reflects both material that has been 'fixed' by the algae in the lake (which has been washed into the lake from the surrounding soils in the watershed by overland and throughflow) and also nitrogen of any plant material (e.g. leaves, seeds, twigs) washed into and preserved in the lake sediment. The spatial representation of the nitrogen record is therefore mainly a reflection of changes occurring both in the basin and in the soils of the local watershed of the Kiri-tó catchment. Work from GIS modelling estimates that this covers a maximum spatial area of 21 km^2. $\delta^{13}C$ measurements were made alongside the $\delta^{15}N$ measurements. These record the ratio of $^{12}C/^{13}C$ ($\delta^{13}C$) in the organic lake sediment and can provide an indication of the type of organic carbon in the sedimentary sequence (i.e. algae or terrestrial plant material) and from this, the possible source of the organic nitrogen being measured (Meyers 1994). The spatial representation for the $\delta^{13}C$ is therefore again very local.

Methods

Field and laboratory techniques

A 3 m sedimentary sequence in 0.5 m sections was collected from Lake Kiri-tó using a modified Russian corer. The core was extruded in the field, wrapped in cling-film and aluminium foil and transported back to the School of Geography, University of Oxford for analyses. In the laboratory, 1 cm^3 sub-samples of sediment were extracted down the core using a volumetric sub-sampler. The whole sequence was sub-sampled at a 16 cm interval and the section of the core of most interest (i.e. 8000–4500 cal BC) was sampled every centimetre. Two sub-samples were collected at each interval; one for pollen and microfossil charcoal analyses, the other for stable isotope and total organic nitrogen analyses. Seven sedimentary samples (covering approximately 1 cm depth for each sample) were also taken for ^{14}C AMS dating (carried out by Beta Analytic, USA).

Extraction of pollen from the sediment samples followed standard procedures (summarised in Bennett and Willis 2001) and involved the addition of acids to remove the carbonates, alkali and acetolysis to remove humic acids and polysaccharides, and hydrofluoric acid to remove silica and silicates. The pollen remaining in the sample was then stained and mounted in silicone oil for identification and counting. A known quantity of exotic pollen was added to each sample before processing in order to determine the pollen and microfossil charcoal concentration (Stockmarr 1971). Identification of the pollen in the samples was made using comparison with various keys and photographs (e.g. Reille 1992; 1995; 1998) and comparison with pollen reference material in the collection of the Oxford Long-term Ecology laboratory. In order to ensure a statistically significant sample (Maher 1981) size a minimum count of 300 pollen grains was counted for each level analysed.

Samples for microfossil charcoal analysis were prepared as part of the routine pollen analysis (Whitlock and Larsen 2001) and the charcoal concentration in each sample determined using the point count method (Clark 1982). This provides an estimate of the area of charcoal covering each slide counted. By assessing this measurement against the exotic pollen count, a measure of charcoal concentration ($cm^2\,cm^{-3}$) per sample was obtained.

Extraction and measurement of $\delta^{15}N$, $\delta^{13}C$ and TON in the sedimentary sequence was carried out using standard procedures (Talbot 2001). Subsamples of approximately 1 cm^3 were taken throughout the core at the same sampling interval as for the pollen and microfossil charcoal samples. The samples were then split into two with one half being used for measurement of $\delta^{15}N$ and TON and the other half for $\delta^{13}C$.

The sedimentary samples for analysis of $\delta^{15}N$ and TON were dried at $< 40°C$ and then ground with a mortar and pestle into a fine even powder and transferred to clean disposable pots for storage. Approximately 40 mg of each sample was then transferred to a small plastic vial for measurement of $\delta^{15}N$ and TON using an x mass spectrometer located in the Research Laboratories for Ancient History and Archaeology (RLAHA), University of Oxford. For measurement of $\delta^{13}C$, the subsamples were sieved through 500 micron sieves using ultrapure water and then washed in 1 M hydrochloric acid. The samples were then dried at approximately 40°C, ground into a fine powder using a pestle and mortar and transferred to clear disposable pots for storage.

10 mg of each sample was transferred to a small plastic vial for measurement of $\delta^{13}C$ using the mass spectrometer at RLAHA.

Data handling

Once all the preliminary data (pollen counts, microfossil charcoal counts measurements of $\delta^{15}N$, $\delta^{13}C$ and TON and ^{14}C dates) were obtained, a number of data-handling techniques were employed in order to compare and contrast the various datasets. These were as follows:

The radiocarbon dates were calibrated using the programme INTCAL98 (Stuiver *et al.* 1998) (cal yr BP) and subsequently converted to cal AD/BC. The relationship between age and depth was modelled using linear interpolation where estimated deposition times were calculated from the gradients between adjacent pairs of points (Bennett and Heegaard 2006). This enabled calculation of interpolated ages for intermediate depths.

The pollen data were converted to pollen percentage data. This involved expressing the value for each pollen type counted in a sample as a percentage of the sum of all the pollen and spores of vascular plants counted in that sample, excluding aquatics. Aquatics were excluded from the sum due to their presence in the lake and therefore probable over-representation in the pollen sum. Aquatics were, however, grouped and then combined with the main sum to give an indication of the frequency of each type. The resulting pollen percentage data were plotted in a pollen diagram against age and depth using the plotting programme *Psimpoll* (Bennett 2005). The same programme also enabled the plotting of the microfossil charcoal results (expressed as $cm^2\,cm^{-3}$).

The resulting pollen percentage diagram was zoned in order to determine where the main changes in vegetation occur in the diagram. Zonation was carried out using optimal splitting (Birks and Gordon 1985; Bennett *et al.* 1992) as part of the *Psimpoll* programme (Bennett 2005) where the diagram is divided into a given number of zones in such a way as to minimize the total variance for that number of zones. The number of zones used is the greatest number for which the splitting is statistically significant.

In order to quantitatively view any trends in the pollen and microfossil charcoal dataset independent of those related to depth, principal components analysis (PCA) of the pollen percentage and microfossil charcoal data was undertaken using the programme *Psimpoll* (Bennett 2005). The PCA ordination was carried out using a correlation matrix rather than a covariance matrix to counter the problem that the charcoal concentration data is of a different order of magnitude from the pollen percentage data. (The latter is particularly sensitive to absolute values and therefore one set of data may dominate.)

Results

^{14}C dating

Seven radiocarbon AMS dates were obtained for the sedimentary sequence *(Table 6.1)*. From these dates it is apparent that sediment deposition began in the basin from approximately 12,000 BC and has continued to present *(Fig. 6.1)*. Calculation of the sediment accumulation rate using a linear interpolation of these dates suggests that this has been quite variable over this time with intervals of slow accumulation (approximately 1 cm representing 150 years of accumulation) interspersed by more rapid accumulation (approximately 1 cm representing 30 years accumulation). During the period of occupation (i.e. 6000 to 5500 cal BC) the sediment accumulation rate was approximately 1 cm every 100 years. The sampling resolution (at every cm) therefore represents 100-year time-slices across this interval.

Table 6.1. Radiocarbon dates (AMS) from the Kiri-tó sequence. The dates were calibrated using the programme INTCAL98 (Stuiver *et al.* 1998) (cal yr BP) and their probability distributions generated using the programme *Psimpoll* (Bennett 2005). The dates were subsequently converted to cal AD/BC

Depth	Uncalibrated age (yr ^{14}C BP)	Calibrated (cal yr BP)	Calibrated (BC/AD)
202	5150 ± 60	5895 ± 95	3945 ± 95
211	6440 ± 50	7355 ± 50	5405 ± 50
217	7180 ± 40	7995 ± 60	6045 ± 60
228	8620 ± 40	9605 ± 60	7655 ± 60
243	8950 ± 40	10,065 ± 100	8115 ± 100
256	10,270 ± 90	12,069 ± 270	10,120 ± 270
312	11,890 ± 120	13,910 ± 310	11,960 ± 310

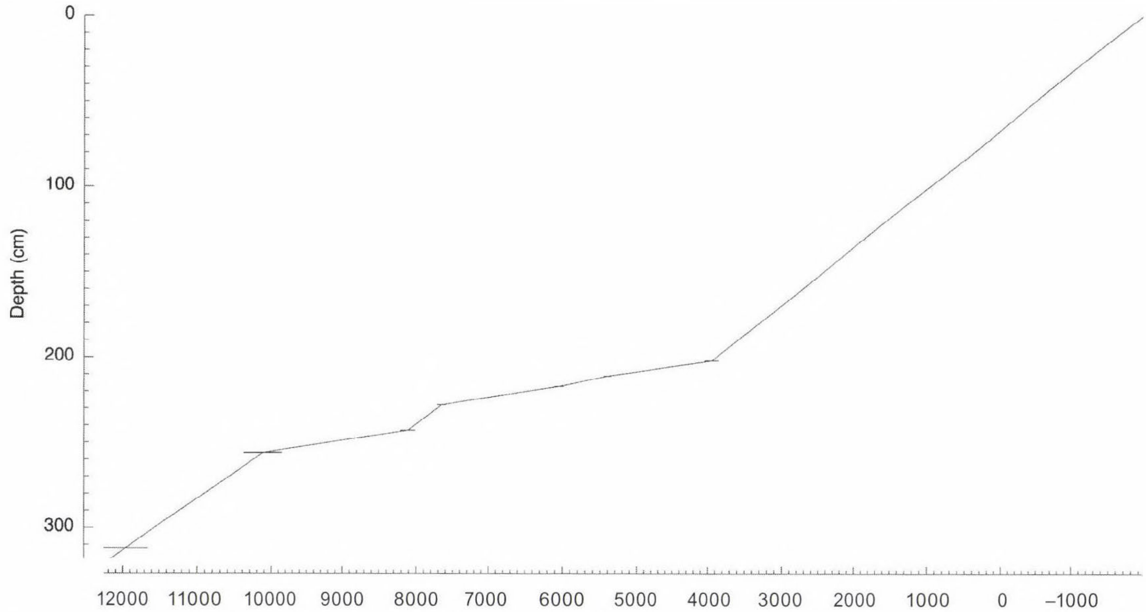


Fig. 6.1. The age-depth relationship for the Kiri-tó sedimentary sequence. A linear interpolation suggests a sediment accumulation rate during the period of occupation (i.e. 6000 to 5500 cal BC) of approximately 1 cm every 100 years

Pollen

Forty-nine samples were analysed for pollen and the results presented in a pollen percentage diagram *(Figs 6.2–3).* Results from zonation of the pollen diagram revealed that the diagram can be divided into four statistically significant zones (labelled k1–k4) as follows: 312–245 cm (c. 12,000–8200 cal BC); 245–219 cm (c. 8200–6200 cal BC); 219–206 cm (c. 6200–4800 cal BC); and 206–128 cm (c. 4800–1800 cal BC). The main features of each will be described briefly in turn.

312–245 cm (c. 12,000–8200 cal BC)

In this lowermost section of the diagram, pollen from needle-leaved trees dominates including pine (*Pinus*), birch (*Betula*) and larch (*Larix*) along with pollen from open-ground herbaceous vegetation. There is also a small but consistent presence of pollen from a few broad-leaved trees including oak (*Quercus*), elm (*Ulmus*), hazel (*Corylus*) and lime (*Tilia*).

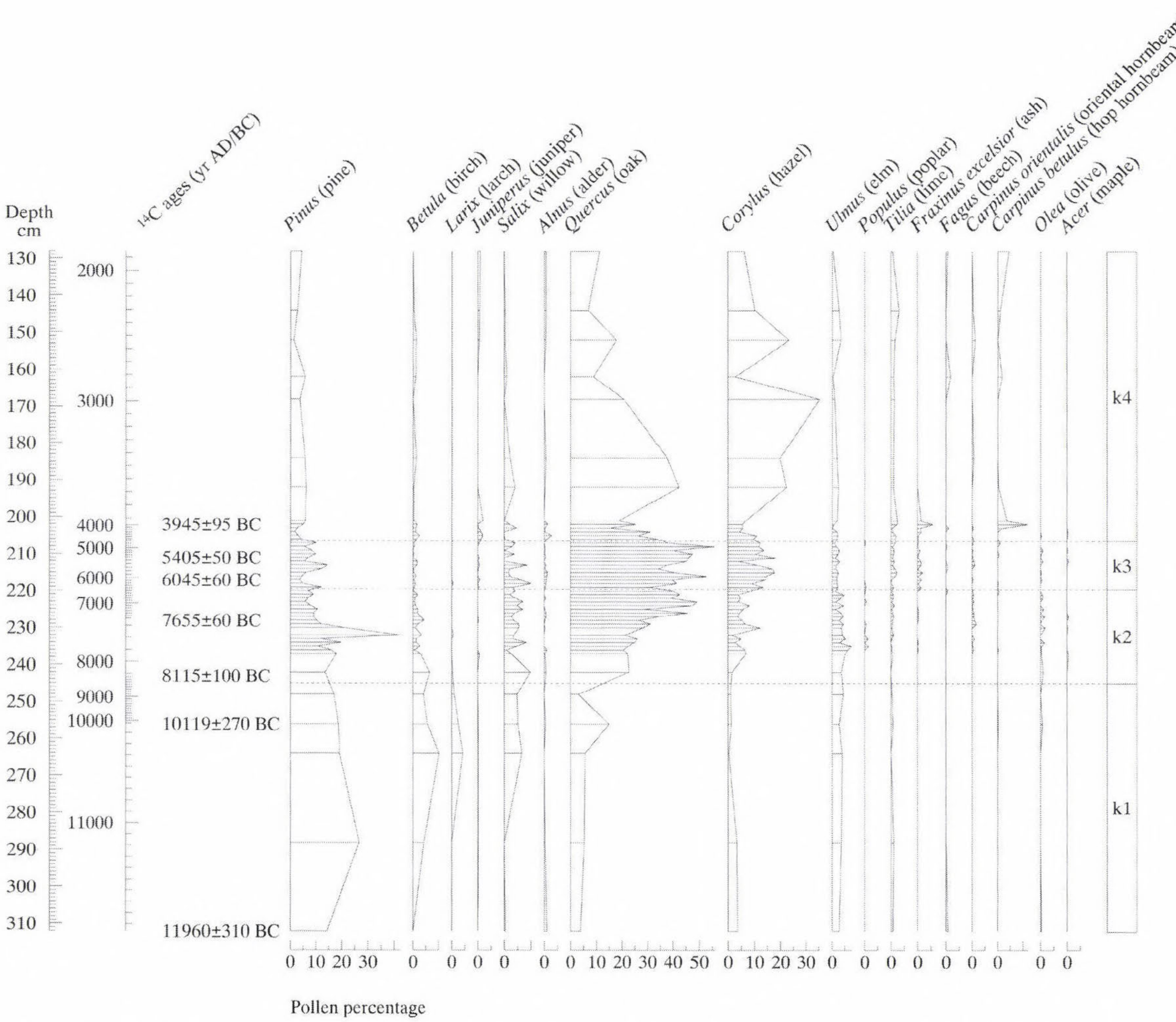


Fig. 6.2. Lake Kiri-tó tree pollen percentage diagram. Percentages of each taxa (calculated as a percentage of the sum of all the pollen and spores of vascular plants excluding aquatics) were plotted against depth. The radiocarbon timescale (see *Table 6.1* and *Fig. 6.1*) is also indicated. Statistically determined vegetation zones (based the method of optimal splitting) are labelled k1–k4

245–219 cm (c. 8200–6200 cal BC)

The section of the diagram, prior to time of occupation by the Körös culture, indicates an interval when the pollen record became increasingly dominated by oak and hazel with a corresponding decline in pine, birch, larch, grasses (Poaceae) and sedges (Cyperaceae).

219–206 cm (c. 6200–4600 cal BC)

The trend to an increasing presence of pollen from broad-leaved trees in the previous zone continues during this interval, with a large increase in hazel pollen along with a small but persistent presence of ash (*Fraxinus*), alder (*Alnus)*, willow (*Salix*), lime and beech (*Fagus*). In the herbaceous pollen there is a further decline in grasses and other open-ground herbaceous types although there is also an increased presence of umbellifers (Umbelliferae) and aquatics. The presence of increased aquatics alongside the Umbelliferae might possibly indicate the umbellifer pollen comes from an aquatic member of family such as *Oenanthe aquatica*.

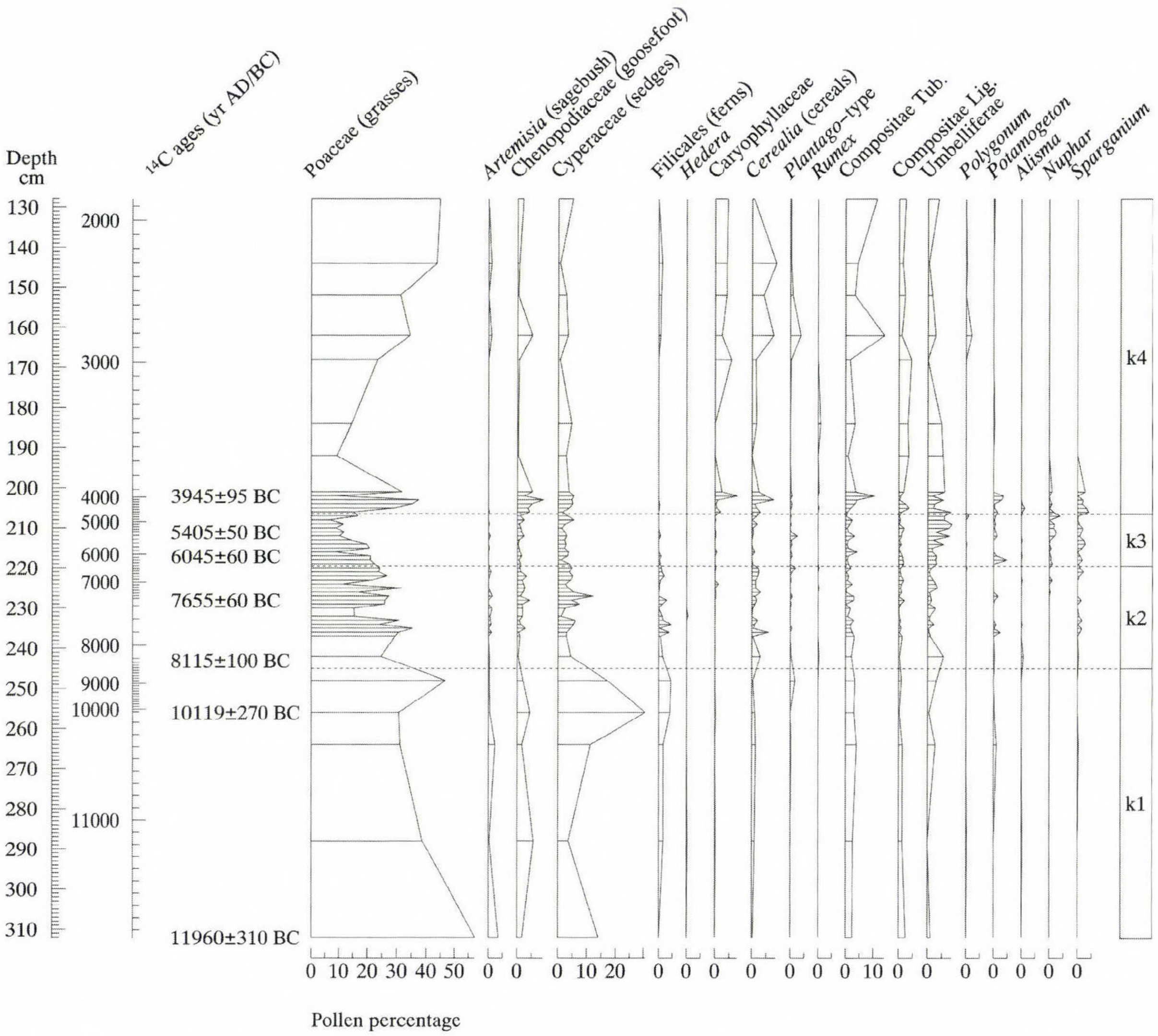


Fig. 6.3. Lake Kiri-tó herbaceous and aquatic pollen percentage diagram. Percentages of each taxa (calculated as a percentage of the sum of all the pollen and spores of vascular plants excluding aquatics; aquatics were grouped and then combined with the main sum to give an indication of the frequency of each type) were plotted against depth. The radiocarbon timescale (see *Table 6.1* and *Fig. 6.1*) is also indicated. Statistically determined vegetation zones (based the method of optimal splitting) are labelled k1–k4

206–128 cm (c. 4600–1800 cal BC)

From approximately 4600 cal BC there is a large decline in tree pollen, in particular oak and hazel, and a corresponding increase in pollen from grasses, other open-ground herbaceous types such as Compositae and cereals. This interval possibly indicating an of opening up of the landscape, is however, relatively short and from approximately 3800 cal BC, pollen from broad-leaved trees once again increases to dominate the pollen signature. From approximately 3000 cal BC another reduction in tree pollen occurs and from this point onwards evidence from the pollen record suggests that it is probable that the present day landscape became established.

Results from the analysis of the microfossil charcoal record are presented in *Fig. 6.4.* The pollen diagram zones have been included for comparison. In the lower most section of the diagram (i.e. pollen zone k1) the input of microfossil charcoal to the basin was small with the low but continuous values recorded at every level and probably reflecting low-frequency natural burning of the forests. From approximately 8000 cal BC (pollen zone k2) concentrations of microfossil charcoal in the sedimentary sequence start to gradually rise possibly indicating a small increase in regional burning. A significant increase in microfossil charcoal concentration occurs, however, between approximately 6000–5500 cal BC when values increased fourfold (to between 0.6–0.9 $cm^2 cm^{-3}$) possibly reflecting either a change in the nature, or frequency, of the fires. For the remainder of the diagram (i.e. 5500–1800 cal BC) values of microfossil charcoal are highly variable although the peaks seen between 6000–5500 cal BC are not reached again.

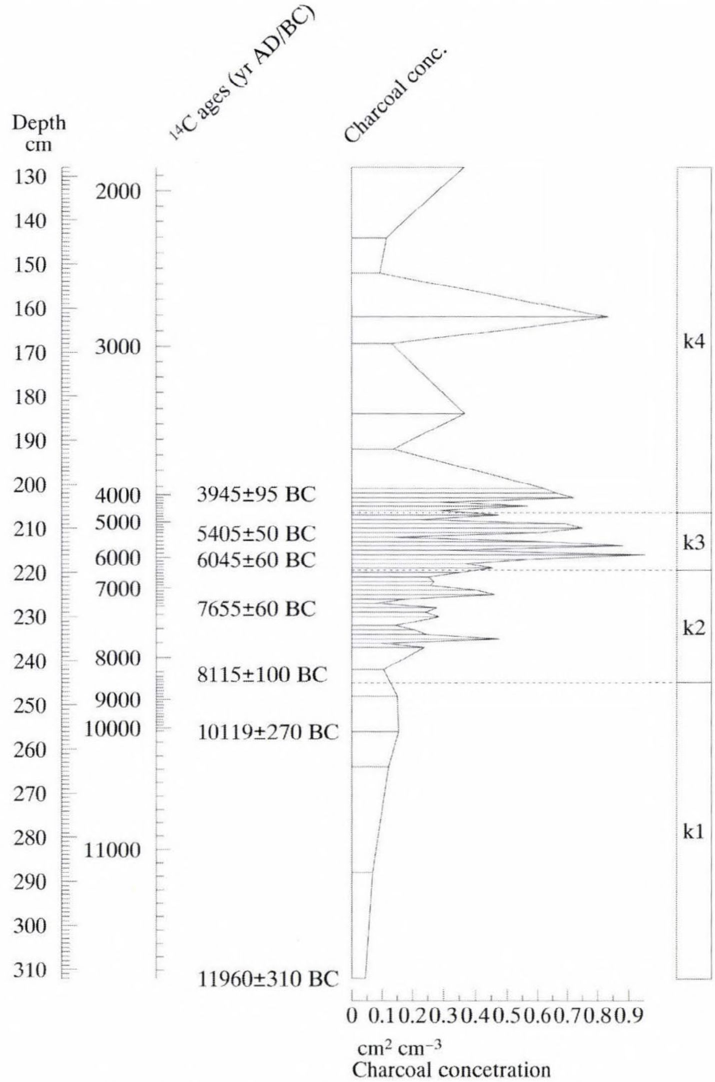


Fig. 6.4. Lake Kiri-tó microfossil charcoal diagram. Concentration values ($cm^2 cm^{-3}$) are plotted against depth. The radiocarbon timescale (see *Table 6.1* and *Fig. 6.1*) is also indicated

Nitrogen and carbon

Results of the nitrogen and carbon analysis are presented in *Fig. 6.5.* Although the extraction and measurement of $\delta^{15}N$ and TON in lake sediments is a reasonably well-established technique, its main use to date has been in the reconstruction of the relationship between climate change, vegetation dynamics and nitrogen cycling (e.g. Talbot and Johannessen, 1992; Wolfe *et al.* 1999). In contrast the examination of $\delta^{15}N$ in lake sediments to detect past human influence upon the soils in has rarely been carried out; yet investigations on modern lakes with sedimentary sequences spanning the last 100–200 years indicate that it can provide important additional information on the impact of agricultural and sewage disposal practices (Talbot 2001). A study of sediments from Lake Ontario (Canada), and the Greifensee (Switzerland), have revealed for example, rising trends in $\delta^{15}N$ and TON from the nineteenth through to the twentieth centuries. This is thought to be associated with increased effluent discharge into the lakes (sewage N is relatively enriched in $\delta^{15}N$) (Heaton 1986) and increased input of soil N into the basin due to deforestation and agriculture.

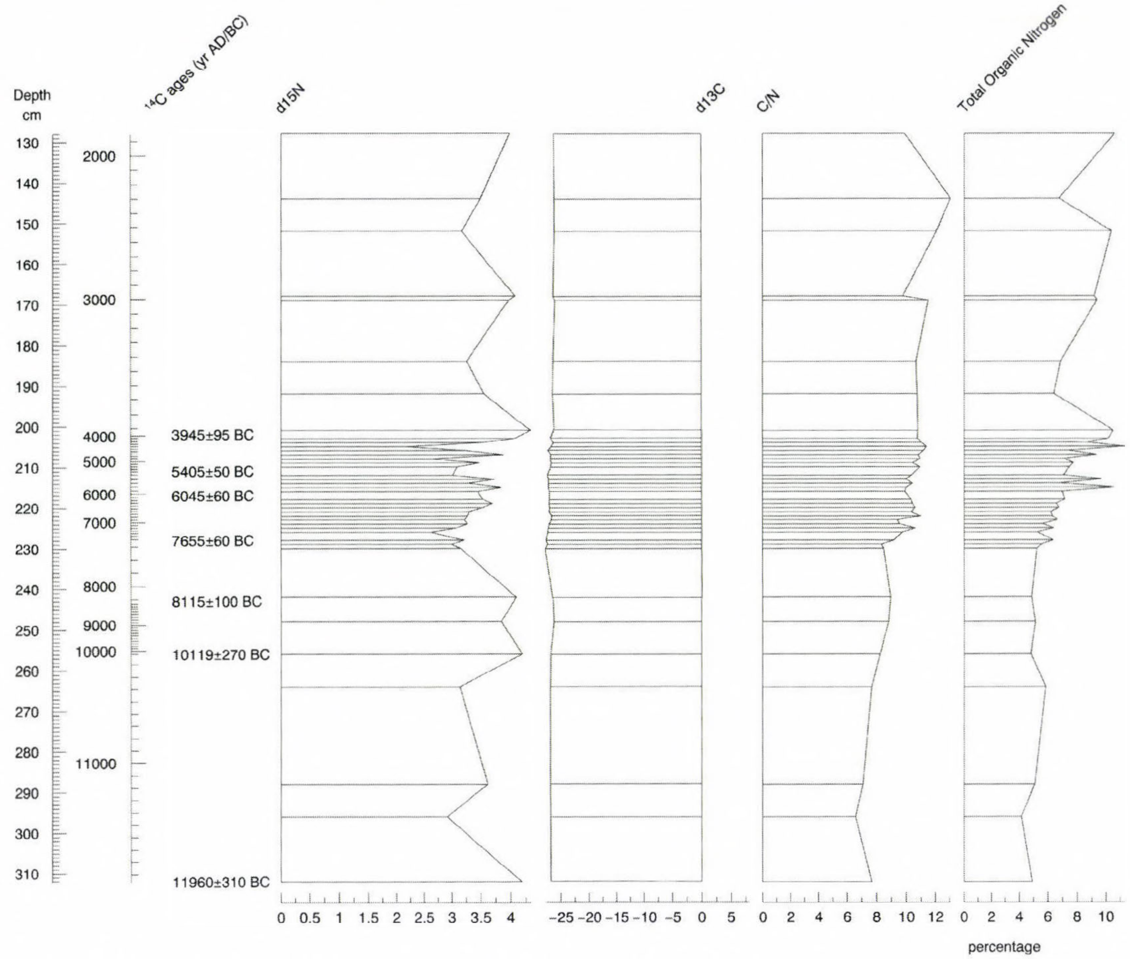


Fig. 6.5. Carbon and nitrogen elemental (% and C/N ratio) and isotope ($\delta^{13}C$ and $\delta^{15}N$) stratigraphy for Lake Kiri-tó

There are a number of mechanisms, however, which can account for changing values of $\delta^{15}N$ and TON in lake sediment and fundamental to their interpretation is a knowledge of the origin of the organic matter from which the values are derived (Wolfe *et al.* 1999). One of the most important things to determine is whether the values are derived from changes in aquatic productivity (recorded in algae) and thus reflecting changes in the amount and type of dissolved inorganic nitrogen entering the basin in response to changes in and around the basin, or a change in the input of macrofossils of terrestrial origin. If it is the latter case, for example a change from organic lake mud to terrestrial plant material (needles, leaves, twigs), then these two sources have very different ^{15}N signatures and the ratio of ^{15}N to ^{14}N may be reflecting a change in input of plant material rather than any other process.

A method to determine the source material of the organic matter in the sedimentary sequence is to measure the $\delta^{13}C$ value of the organic material. This is because most terrestrial plants found in central and eastern Europe (all the trees and shrubs, for example and most herbaceous plants) are C_3 plants (those that produce phosphoglyceric acid (containing three carbon atoms) as the first product of photosynthesis). These have a $\delta^{13}C$ value between –25‰ to –29‰. In contrast algae have a $\delta^{13}C$ value between –12‰ to –26‰ (Talbot and Johannessen 1992; Meyers 1994). Using a measure of the $\delta^{13}C$ it should therefore be possible to determine the source material for the $\delta^{15}N$. However, the situation is slightly more complicated than this because C_4 plants (those that produce oxaloacetic acid (containing four carbon atoms) as the first product of photosythesis) and aquatic plants have a $\delta^{13}C$ value between –12‰ to –16‰ and therefore have overlap with the algae values. C_4 plants are mainly those adapted to hot and seasonally dry conditions but include, significantly for this region, some grasses (Poaceae) and sedges (Cyperaceae). Evidence from the pollen diagram *(Fig. 6.4)* indicates that aquatic plants, grasses and sedges were growing in an around the lake. Therefore a further method to determine whether organic material with a $\delta^{13}C$ value of between –12‰ to –16‰ is from a C_4 or aquatic plant, or algae, is to measure the C/N ratio. This is because algae typically have an atomic C/N ratios between 4 and 10, whereas vascular plants (which include aquatics) have C/N ratios $\geq$ 20 (Meyers 1994).

Results from the nitrogen and carbon measurements are presented in *Fig. 6.5.* The first thing to note is that the organic matter from which the $\delta^{15}N$ values are taken is almost certainly algae since the material has a $\delta^{13}C$ value of around –25‰ and a C/N ratio between 8 and 12. It is also probable that this has remained the principal source throughout the sequence; there is very little variation in either of these values throughout. The total organic nitrogen and $\delta^{15}N$ measurements therefore reflect the type and amount of nitrogen being taken up and 'fixed' by the algae communities in the lake sediment. With this in mind the total organic nitrogen measurements indicate some interesting trends, especially when compared to the other proxies recorded in this sequence. Overall they suggest an increase in the amount of dissolved inorganic nitrogen in the basin up through the sequence, which is much to be expected. However, they also indicate peaks in total organic nitrogen during the occupation phase (6000–5500 cal BC), and later from approximately 4500 cal BC, an interval during which the pollen evidence suggests extensive human impact at or near the site.

The $\delta^{15}N$ measurements are more variable up through the sequence and are probably a reflection of the number of difference processes (both physical and chemical) that can affect the isotopic ratio of ^{14}N to ^{15}N in lake sediments. It is beyond the scope of this chapter to go into detail of these processes here (for a review see Talbot 2001), but it is probable that the processes responsible for the relatively high $\delta^{15}N$ values prior to approximately 8000 cal BC are different to those responsible for the peaks seen to correspond with the TON peaks during the occupation phase and from 4500 cal BC. This assumption is based on the differences noted in the TON values.

One suggestion for the relatively high $\delta^{15}N$ associated with low values of TON prior to 8000 cal BC is that this is indicative of arid conditions during the early postglacial in Hungary (Willis *et al.* 1995). Aridity would have resulted in a predominance of evaporative processes in the soils and consequently the volatization of ammonium. This process is known to result in a nitrogen pool that is relatively enriched in $\delta^{15}N$ (Talbot 2001).

In contrast the peaks in $\delta^{15}N$ during the occupation phase and from 4500 cal BC (and associated with increases in total organic nitrogen) are possibly reflecting an increased uptake of N by the algae. This could result, for example, from more dissolved inorganic nitrogen entering the basin due to anthropogenic factors such as manuring and fertilisation of soils as well as sewage. Previous research has demonstrated that an increase in the amount of dissolved inorganic nitrogen (DIN) in a lake basin results in preferential incorporation of ^{14}N into algal cell material inevitably leading to a corresponding ^{15}N enrichment in the remaining DIN and subsequently the sedimentary record (Talbot 2001).

Principal Components Analysis

Results from the ordination of the Kiri-tó dataset *(Fig. 6.6)* reveal that over 80% of the variance in the dataset can be accounted for in the first two axes and that the main direction of variance in the dataset indicates three vegetation clusters; a vegetation dominated by pine, birch, elm, grasses and

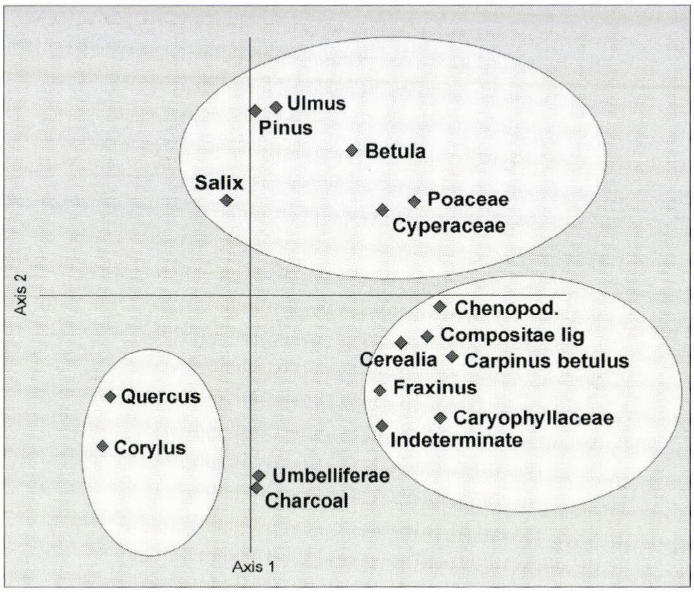


Fig. 6.6. Principal component analysis (PCA) of the Kiri-tó dataset displaying the main direction of variance in the dataset. Over 80% of the variance is accounted for in the first two axes and three distinct vegetation clusters are identified (as indicated)

sedges, a second dominated by oak and hazel, and a third with a predominance of herbaceous types usually associated with disturbed ground (e.g. Compositae), cereals, ash and hornbeam. Charcoal appears to be closely associated with Umbelliferae although as mentioned above it is not clear whether this is an aquatic member of this family or a type associated with open and/or disturbed land. The fact that charcoal appears not to be closely associated with other open ground indicators such as grasses (Poaceae) or Compositae tends to support the aquatic interpretation and further suggests that the charcoal is indicative of burning in hearths rather than widespread clearance using fire. It may also suggest a link between burning of hearths and flooding regimes.

Discussion

Late-glacial environment

Palaeoecological evidence from Kiri-tó (*Fig. 6.2:* pollen zone k1) suggests that the late-glacial environment around Ecsegfalva consisted of an open parkland where steppic grassland (dominated by grasses, sedges (Cyperaceae), sagebush (*Artemisia*) and goosefoot (Chenopodiaceae) was interspersed by stands of needle-leaved trees (mainly pine and larch). Some broadleaved trees, however, were also present. These included types such as birch, willow and a small but persistent presence of oak, hazel, elm and lime. This reconstructed late-glacial environment is very similar to that found elsewhere in Hungary, both from pollen records (e.g. Willis *et al.* 1995; Willis *et al.* 1998; Magyari *et al.* 1999; Magyari 2002) and also extensive macrofossil charcoal records indicating *in situ* growth of trees (e.g. Willis *et al.* 2000; Rudner and Sümegi 2001). As mentioned in these previous reconstructions, the late-glacial landscape of Hungary was certainly not treeless. The needle-leaved and broad-leaved vegetation present are types that are found presently in the southern margins of the boreal forest and are known to have physiological capabilities that could have withstood the climatic extremes of the full and late-glacial environments (Willis and van Andel 2004). The essentially treeless environment of the present day Hungarian Plain is not therefore a relict of the late-glacial environment and is a more recent phenomenon.

Evidence from the charcoal record *(Fig. 6.4)* suggests that there was a low level of 'background' burning of the landscape during the late-glacial; this was almost certainly due to natural forest fires probably in response to the late-glacial aridity. It would also appear from the pollen evidence that the environment around the Kiri-tó meander was fairly dry during the late-glacial; very few aquatics (e.g. *Potamogeton, Alisma, Nuphar, Sparganium*) are recorded in this section of the core in comparison to other periods *(Fig. 6.3).* It is also probable that the nutrient status of the soils surrounding the basin was poor with evidence suggesting relatively low values of total organic nitrogen in the basin *(Fig. 6.5).*

Early postglacial environment

The late-glacial/ postglacial transition at 9600 cal BC does not feature significantly in the Kiri-tó pollen diagram (*Figs 6.2–3:* pollen zone k2); it is not until approximately 8300 cal BC when a large increase in broadleaved trees occurred, resulting in a woodland dominated by oak and hazel but also containing a number of other tree taxa including elm, lime, oriental hornbeam (*Carpinus orientalis*) and olive (*Olea*). Such an increase in deciduous woodland is seen throughout central Europe from approximately 9000 cal BC and is taken to be indicative of a response of the vegetation to the warmer and wetter climatic conditions of the postglacial. The relatively late postglacial expansion of deciduous trees in Kiri-tó is noted in some other sequences from eastern Hungary (e.g. Willis *et al.* 1998). In these sequences it is suggested that this is probably a reflection of both the dry climatic conditions and nutrient poor and cold soils in Hungary during the early postglacial; the same is also probably the case for the environment around Ecsegfalva.

Corresponding with the expansion of deciduous trees there is also a decline in grasses and herbaceous vegetation from approximately 8500 cal BC *(Fig. 6.3).* However, these open-ground types still account for over 40% of the total pollen suggesting that although deciduous woodland became established, there was an open-canopy. The early postglacial landscape around Ecsegfalva was therefore probably closer to a parkland-type environment rather than dense forest.

A small but significant presence of cereal pollen is recorded in the Kiri-tó diagram from approximately 8200 cal BC. Some of this might be from wild varieties of cereals that are known to have grown in eastern Europe during the late-glacial/ early postglacial. However, it is also likely that some of these grains are from the aquatic grass, *Glyceria.* This pollen type is very difficult to distinguish from cereal based on morphology alone. Support for this interpretation is provided by evidence for phytoliths of *Glyceria* in the core (see Windland, chapter 7). In addition a number of other aquatic pollen types appear in the sequence for the first time from approximately 8200 cal BC including *Sparganium* and *Potamogeton (Fig. 6.3).* The presence of these aquatics suggests that the area around Ecsegfalva was becoming wetter during this interval and that periodic flooding of the floodplains around the Kiri-tó meander was probably occurring.

With the expansion of deciduous woodland, changes were also probably occurring in the soils around Ecsegfalva *(Fig. 6.5).* There is evidence for a decrease in $\delta^{15}N$ from approximately 8100 cal BC, possibly indicating increased nutrient cycling in the slopes surrounding the basin and the development of deeper soil profiles. A corresponding increase in the percentage of total organic nitrogen entering the basin is also recorded from this time supporting this interpretation *(Fig. 6.5)* and suggesting that more nitrogen is available to be fixed by the aquatic algae in the basin.

Environment during the occupation by the Körös culture

In order to examine and compare the environment during occupation by the Körös culture, a summary diagram has been constructed comparing results for the fossil pollen, charcoal and nitrogen records *(Fig. 6.7).* What is immediately apparent from this diagram is that during the interval of occupation (6000–5500 cal BC) there was a significant increase in burning and a small increase in total organic nitrogen. Interpretation of each of these proxies needs to be assessed alongside the evidence from the pollen indicating changes to the vegetation in and around the site.

During the interval 6000–5500 cal BC there is very little evidence of clearance of the landscape by the Körös culture. Mixed stands of oak and hazel with elm and lime probably covered much of the surrounding area, at least on the higher 'islands' of land. A slight reduction in oak and then hazel is noted in the pollen diagram with a small corresponding increase in pine *(Fig. 6.7)* which is possibly related to anthropogenic activities but there is certainly no evidence for

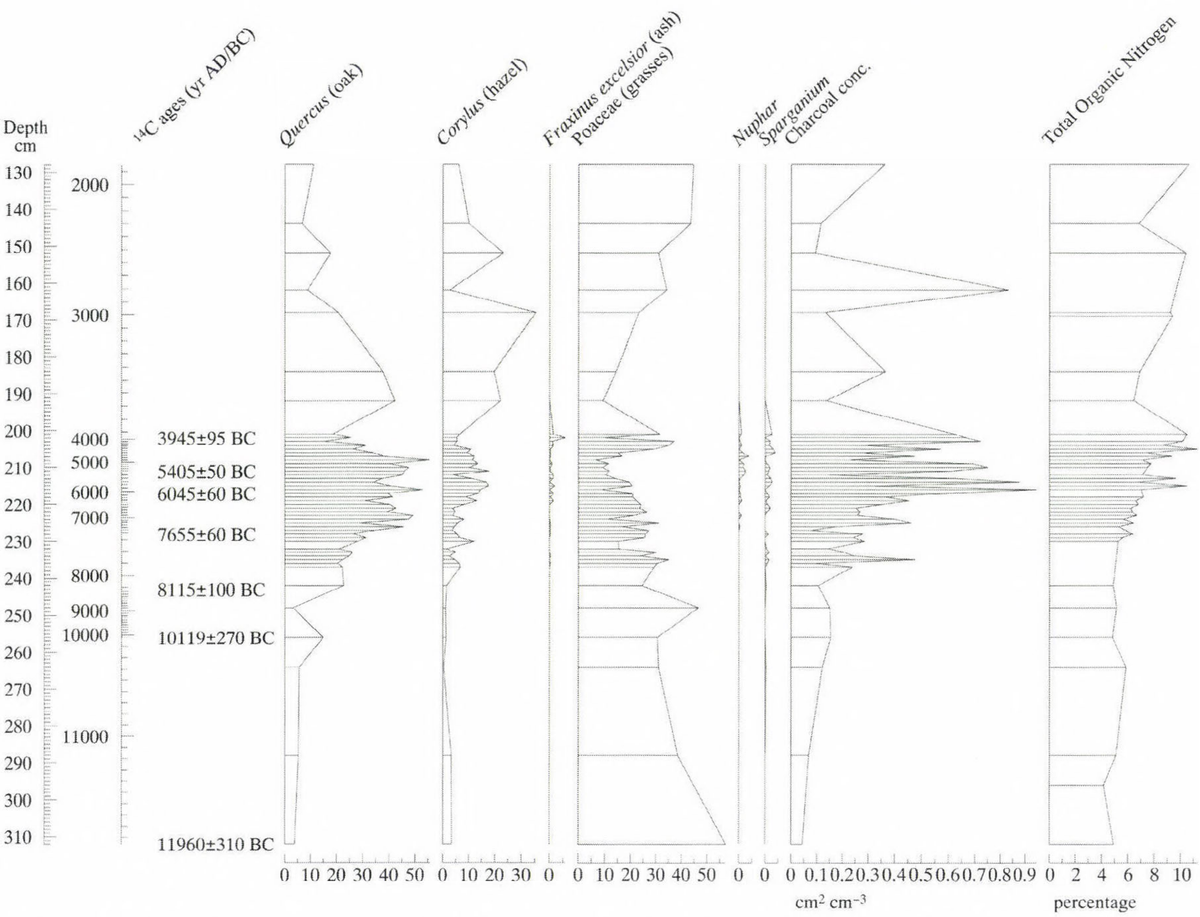


Fig. 6.7. Composite diagram to compare selected curves (from *Figs 6.2–5*) of pollen percentage, charcoal concentration and total organic nitrogen from Lake Kiri-tó sequence

widespread clearance of the trees. Grass pollen and open ground herbaceous types apparent in the diagram at this time are probably indicative of the vegetation growing in the more low lying areas, such as the flood plains of the Kiri-tó.

The presence of ash trees (*Fraxinus excelsior*) from approximately 6000 cal BC *(Figs 6.2–3)* is an interesting feature to note in the diagram since ash is a species that is tolerant of water-logging and may well be indicative of a wetter environment or flooding of the Kiri-tó from this time onwards. Another indicator of higher water levels from this time can be seen in the more persistence presence of aquatic plants including *Polygonum*, *Potamogeton*, *Alisma, Nurphar* and *Sparganium (Fig. 6.3).* Interestingly, however, sedges were not a major component of the local or regional vegetation during the time of the Körös culture. This is in contrast to the late-glacial and early postglacial (between approximately 10,000 to 8200 cal BC) and also present day where there are extensive sedge communities in the water channels surrounding the site. A number of suggestions can be made for the apparent reduction in these sedge communities, the most obvious being that such plants thrive in intermittently damp (or dry), alkaline conditions but if the frequency of waterlogging becomes too continuous, they will cease to persist.

It is against this landscape reconstruction that we need to view the charcoal results *(Fig. 6.7).* Since the large increase in charcoal between approximately 6000–5500 cal BC does not appear to be associated with a significant reduction in woody species, it is probable that this record represents charcoal resulting from anthropogenic activities on-site including hearths or fires for cooking and warmth. The fact that there is no major transition in vegetation type during the time of the Körös culture also suggests that the small increase in total organic nitrogen and also $\delta^{15}N$ *(Fig. 6.5)* is probably related to on-site activities. These could include both intentional addition of nitrogen to the soil through manuring and unintentional from sewage including dung.

After the Körös culture

The two most significant changes apparent in the fossil records following on from the Körös culture occupation are a reduction in charcoal and total organic nitrogen from approximately 5500 cal BC. No other changes are apparent in the pollen record, again emphasising the minimum impact that the Körös culture had upon the landscape. This is in direct contrast to evidence in the pollen diagram for a significant reduction of the woodland trees and large increase in grasses and open ground herbaceous types from approximately 5000 cal BC *(Figs 6.2–3)*. There is also an associated increase, once again, of charcoal and total organic nitrogen *(Fig. 6.7)*. It is beyond the scope of this chapter to examine in detail the reasons for this reduction, but during this time there is evidence for occupation of the region by the AVK and it is highly probable that these people were responsible for this 'clearance' event. The fact that the Körös culture had very little impact upon the landscape yet the AVK culture had a significant impact highlights raises some important questions for future research. For example, does this indicate an increase in the number of people in the region, hence a greater impact on the landscape? Or is this a reflection of the different tools and/or farming methods in use?

Between 3900–3700 cal BC the woodland once again recovered *(Fig. 6.2)* with oak and hazel returning to their former values. However, from approximately 3000 cal BC clearance occurred again and this time the woodland elements in the landscape never regained former values. It is therefore probable that this is the time, from the Late Copper Age onwards, when, at least in this section of the Great Hungarian Plain, the present day open landscape became established.

Conclusions

From this study a number of conclusions can be drawn about the impact of the Körös culture on the landscape as follows:

1. The early farmers associated with the Körös culture responsible did not undertake significant clearance of the landscape and were certainly not responsible for the creation of the present day open landscape seen in this region.
2. Locally available wood during the time of the Körös culture occupation included oak, hazel, lime, elm, pine, birch willow and ash. Lack of wood for building material cannot therefore be an explanation for why the Körös people built their settlements out of reeds.
3. Although there is compelling evidence from the on-site archaeobotanical and faunal studies for the growing of crops and animal husbandry, there is no direct evidence in the pollen record for clearance of large tracts of landscape for these activities. One possible suggestion therefore is that there was already enough open land available on the floodplains for these activities without the need to cut-down trees. This is, however, in direct contrast to later cultures (e.g. AVK) who undertook significant clearance of the woodland taxa.
4. Evidence for animal husbandry and the growing of crops is found, however, in the nitrogen record. An increase in total organic nitrogen and $\delta^{15}N$ are recorded during the time of occupation by the Körös culture with the suggestion that these are related to intentional (manuring) and unintentional (dung) practices improving the soil quality.

5. The large increase in charcoal concentration apparent during the time of the Körös culture suggests that burning was occurring but given that there is no evidence for a reduction in woody taxa in the pollen record, the conclusion is drawn that this is most probably related to on-site activities such as fires for cooking and warmth rather than burning of the landscape.

In summary it would appear that the people of the Körös culture were living and interacting within the existing landscape. There is very little evidence to suggest that they were significantly altering or over-exploiting their local resources but were rather working in harmony with the environment of the Kiri-tó meander.

Acknowledgements

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Chapter 7

PHYTOLITHS OF THE KIRI-TÓ

Pia Windland

Introduction

Phytoliths are silica bodies found in plant cells. They are found in many plant families though not all, but their production is most abundant in the grasses, possibly 20 times that in other phytolith producing families (Albert and Weiner 2001). They are preserved in soil after the decay of their parent plant material. They are resistant to dissolution in acid or neutral soils, and may survive in alkaline conditions if organic material coats or otherwise protects them, although they are regarded as less likely to be found in alkaline (> pH 9) (Rovner 1983). They may be dispersed by wind or water and have commonly been found in atmospheric dust trapping studies and deep-sea cores having travelled many kilometres. However, their deposition is under most circumstances, by extrapolation from modern analogue studies (Piperno 1988), considered to be more local than that of pollen, possibly occurring at stand level (Rovner 2000). The study of the phytolith record in conjunction with the pollen record from the same site (with its likelihood of originating from a much larger source area), can therefore give a more detailed picture of the local environment. This may help clarify questions relating to pollen source, although the phytolith catchment area, as too that of the pollen rain, will vary from study to study and each association has to be considered uniquely (Twiss 2000).

Two sediment cores were taken from the Kiri-tó, an old oxbow lake beside and beyond the main area of the Ecsegfalva 23 archaeological excavations. One (Core 1) was taken c. 500 m north-west of the site, on the margin of the old oxbow lake, and the other (Core 2) immediately (42 m) to the E of the site, again on the margin of the oxbow. Each core was sampled for both pollen and phytoliths in order to compare the records between the cores and between the proxies. Core 1 was sampled at 1 cm intervals from depths 201–220 cm, to cover the period of interest, and at 8 cm intervals to the top of the core (168 cm depth). Core 2 was sampled at 4 cm intervals from depth 34–144 cm.

Radiocarbon dating indicates that the section of Core 1 examined ranges from approximately 7500 cal BC to 800 cal AD and Core 2 from 4000 cal BC to 1500 cal AD. Although Core 2 thus dates from later than the time of archaeological interest, it has been examined as containing a record of the continuing development of the local environment.

It is hoped these two cores may provide evidence of wild species at the time of the Körös people and so be an adjunct to and contrast with the species identified by phytolith analysis on-site (see Madella, chapter 24).

Method and results

Phytoliths were extracted from core samples of approximately 1 gm. dry sediment with a standard flotation procedure using zinc iodide (Pearsall 2000). After processing, phytolith samples were mounted in microscope immersion oil, allowing them to be turned for identification. A sample size of more than 200 phytoliths was counted at each level; 23 levels were counted in Core 1 and 26 in Core 2; data were then analysed using the PSIMPOLL programme (Bennet 2000). Photographic and descriptive references were used for identification (Geis 1973; Klein and Geis 1977; Mulholland 1986; Mulholland and Rapp 1992; Tubb *et al.* 1993; Ball *et al.* 1996; Pearsall 1997; 2000). In addition a number of slides of modern day plant material were prepared for comparison. These were of species known to be in the area from pollen or from macrofossil remains (Amy Bogaard, *pers. comm.*), of typical waterside species likely to be encountered (Pécsi and Sárfalvi 1964; and Kathy Willis, *pers. comm.*), of a number of grass types and of some old cereal varieties.

Classification of grass phytolith types was based on the the Twiss *et al.* (1969) classification with the refinements of Mulholland and Rapp (1992), separating the short cells into several subgroups as in *Table 7.1*, with two types of very distinctive and consistent box-like rectangular cell

Table 7.1. Phytolith types used in the analysis of the two cores from the environs of the Ecsegfalva archaeological site

Type		Typical Source
Elongated cells Twiss's Elongate class, including smooth, sinuous (Twiss *et al.* 1969, fig. 2, 4a–c) and some long polylobate sinuate shapes		Characteristic of all grasses
Short cells, box type (Within Mulholland and Rapp's Silica-body group, being various types of rectangular or box-like phytolith. (Also Twiss *et al.* 1969, fig. 2, 1g)		Found mainly in Festucoids
Short cells, balls and egg shapes (Twiss *et al.* 1969, fig. 2, 1a and c)		Typical of Festucoid grasses; also found in other groups including dicotyledons
Short cells, rondel type	*Fig. 7.1 a–k*	Found mainly in Festucoid grasses
Box type B1 (Box-like phytolith seen in many samples, consistent in size and shape – probably within Mulholland's Rectangle group)	*Fig. 7.2 a–b*	Possibly Glyceria sp., by comparison with type slide
Box type B2 (A very specific type of deep narrow box-shaped cell – as B1)	*Fig. 7.2 c–d*	Unknown
Trichome; prickle cell. (Hair and papilla phytoliths of various different types and sizes)		All grasses
Dumbells Bi-lobed short cell phytoliths		Mostly in Panicoid grasses; also found in Festucoids but proportions are usually different
Dendriforms	*Fig. 7.2 e–g*	Specific to the inflorescences of Cereales
Bulliform cells Sometimes called 'motor cells'		Found in all grass groups
Cyperaceae type Small hat-shape phytolith		
Rugulose ball		Those seen consistent with types reported from dicotyledonous species (Barboni *et al.* 1999)
Irregular or jigsaw shapes		Generally thought to come from dicotyledonous species
Unknown and corroded Shapes not typical of grasses or known dicotyledonous types, and those too damaged to be identified		

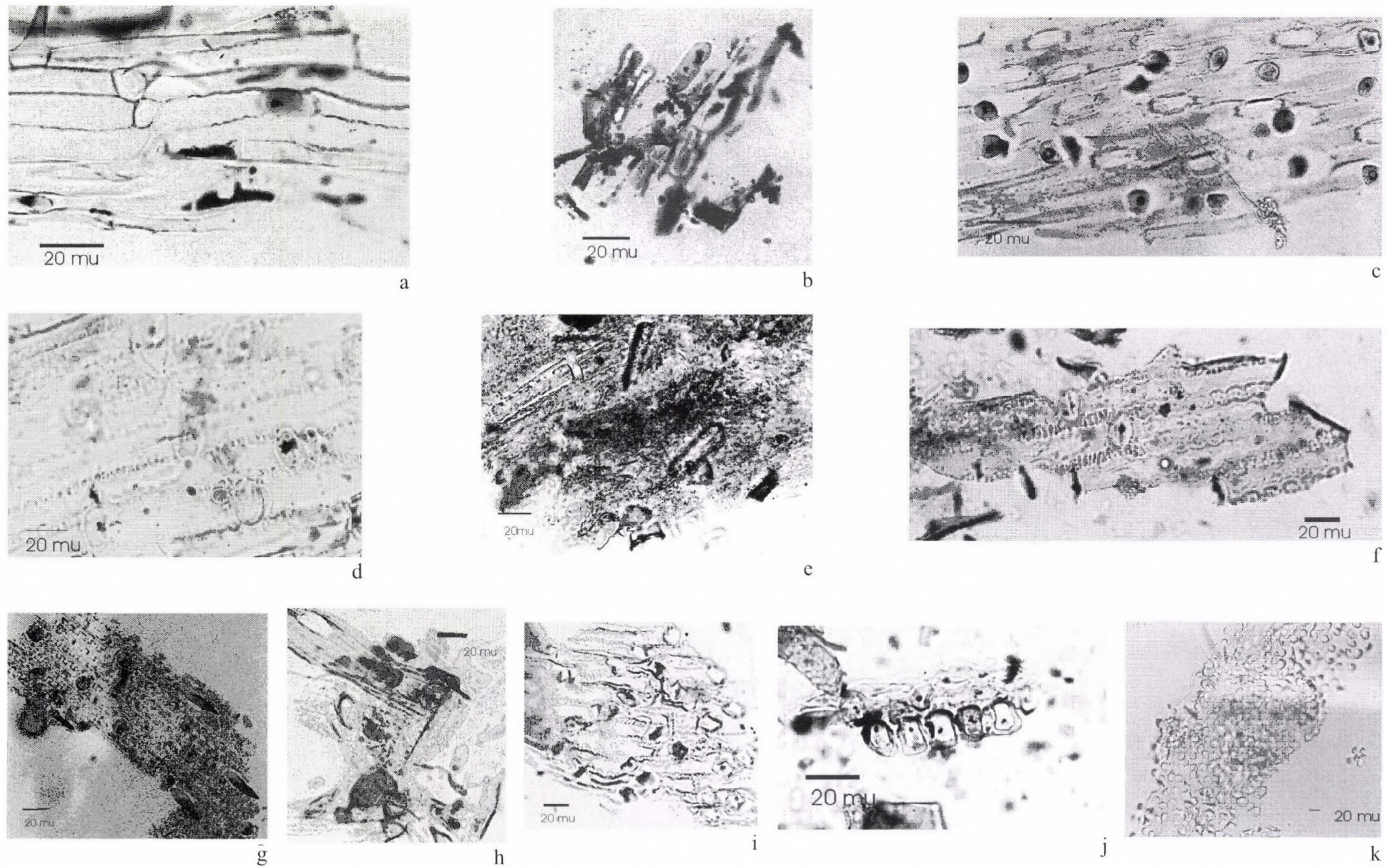


Fig. 7.1. Types of rondel shaped short cell phytolith found in modern day preparations of various tribes of Gramineae. a. Pooeae (Festuca rubra); b. Pooeae (Briza media); c. Seslerieae (Sesleria caerula); d. Glycerieae (Glyceria sp.); e. Bromeae (Bromus cf.arvensis); f. Hordeae (Hordeum vulgare); g. Aveneae (Deschampsia caespitosa); h. Stipeae (Stipa brachitricha); i. Triticeae (Triticum monococcum); j. Arundineae (Phragmites communis leaf); k. Phragmites communis inflorescence

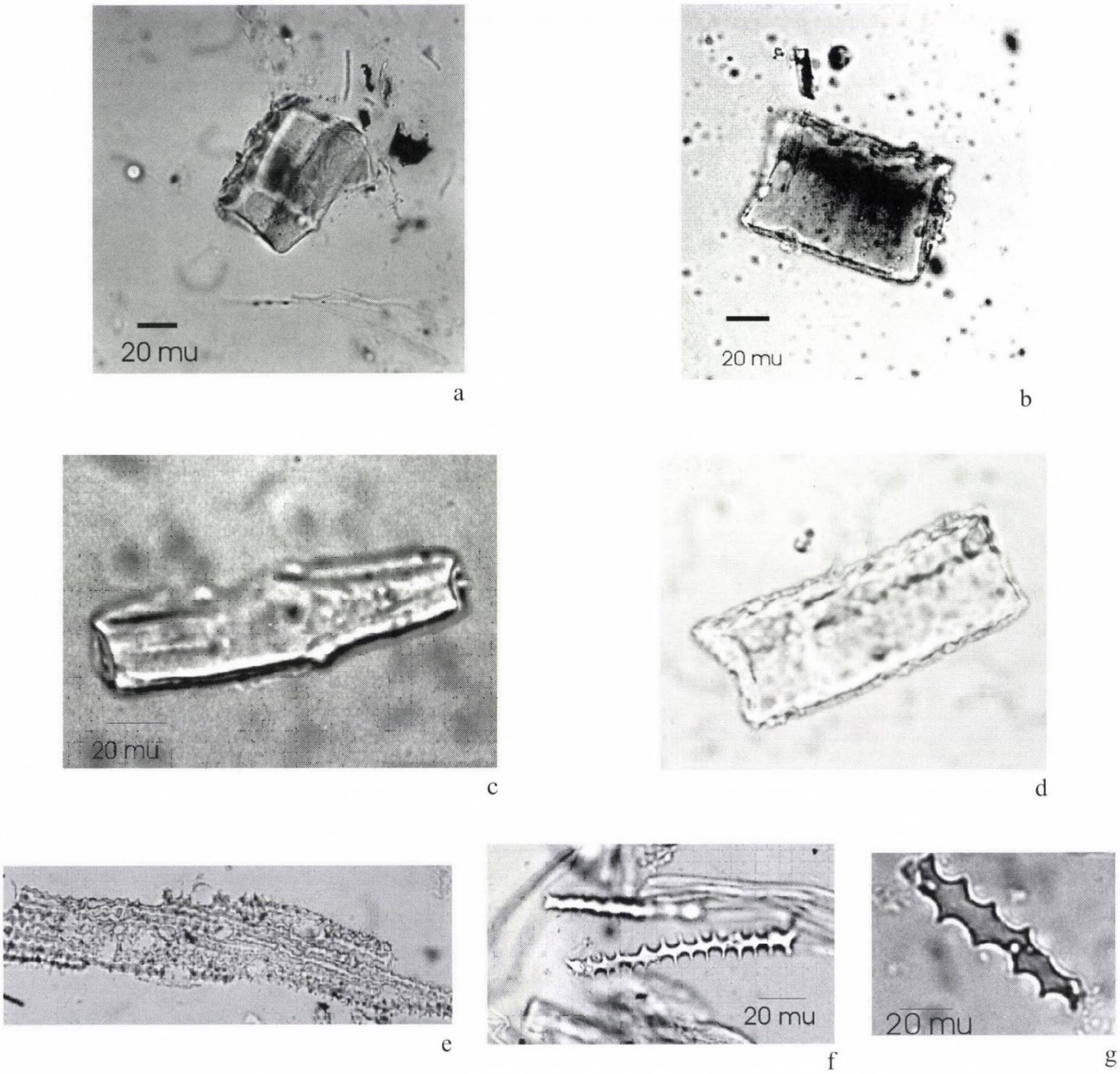


Fig. 7.2. Phytolith types from core samples with reference material for comparison.
a. Boxy rectangular from Glyceria Maxima type slide; b. type B1 from core for comparison; c. Base view of B2; d. Side view of B2; e. Articulated dendriforms from T. monococcum inflorescence; f. Dendriforms from H. vulgare inflorescence; g. Dendriform type from Core 2

counted separately. Bulliform phytoliths were counted as their formation may be positively correlated to dampness of environment (Sangster and Parry 1969). Phytoliths thought to come from *Cyperaceae* and others possibly from dicotyledonous species were also counted *(Table 7.1).*

The PSIMPOLL pollen analysis programme was used to analyse and to display the results graphically *(Figs 7.3–4).*

Phytolith types typical of Festucoid grasses dominated all levels of both cores, providing more than 90% of the types seen. Most of these phytoliths were not assignable to any particular genus.

Dendriform type phytoliths were seen at several depths in both cores *(Fig. 7.2).* Although dendriforms are seen in the inflorescence phytoliths of some wild grasses, those seen here had proportions resembling those found in the inflorescences of some members of Cereales (Ball *et al.* 1996). In Core 1 single examples were seen at depths 213, 216, 218 and 219 cm (approximat-

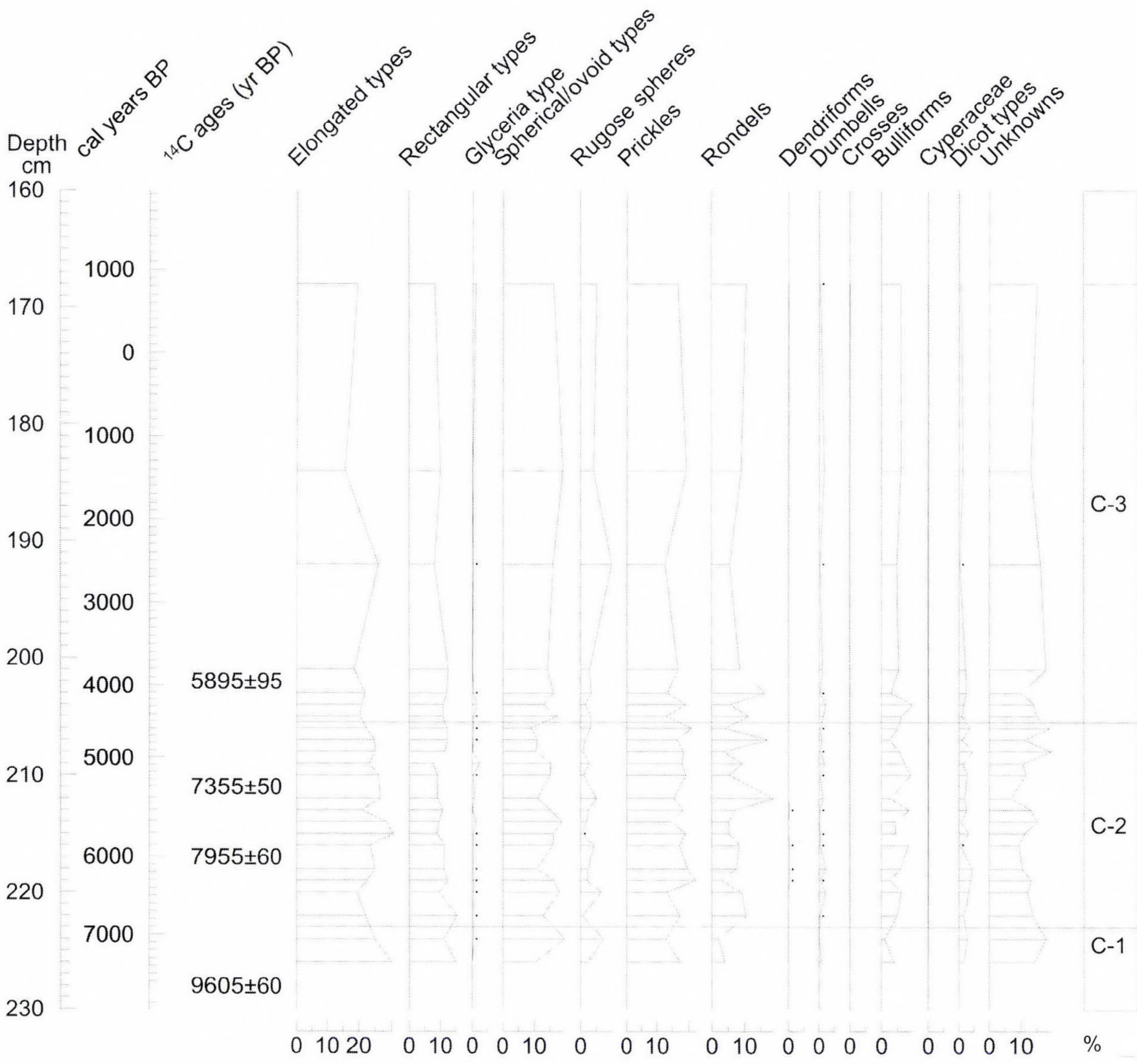


Fig. 7.3. Phytolith types and abundances in Core 1

ing to between 5300 and 6300 cal BC). In Core 2 either one or two were seen at 34, 50, 54, 58, 62, 72, 80, 104 and 112 cm depth; thus, in Core 2, between about 1000 cal BC and 300 cal AD there were one or two dendriform types in each sample examined, with another small cluster of dendriform types between 3000 cal BC and about 2400 cal BC. Cereal dendriforms may, given enough examples, allow the identification of cereal species (Ball *et al.* 1996), but in these Kiri-tó cores not enough examples were seen to enable statistical analysis and further identification was not possible.

Among the short cell phytoliths, mostly non-specific types, two types of box-like phytolith were seen throughout that were extremely consistent in size and shape and unlike any other box-like phytoliths seen. Type B1 was thought possibly to be from a *Glyceria* species, due to its identical characteristics to those seen in type slides of *Glyceria* leaf specimens *(Fig. 7.2).* No similar body was observed in any of the other modern species examined (including 9 tribes of wild grasses and 6 cereal species). Type B2 is unknown but apparently a long thin variant of B1.

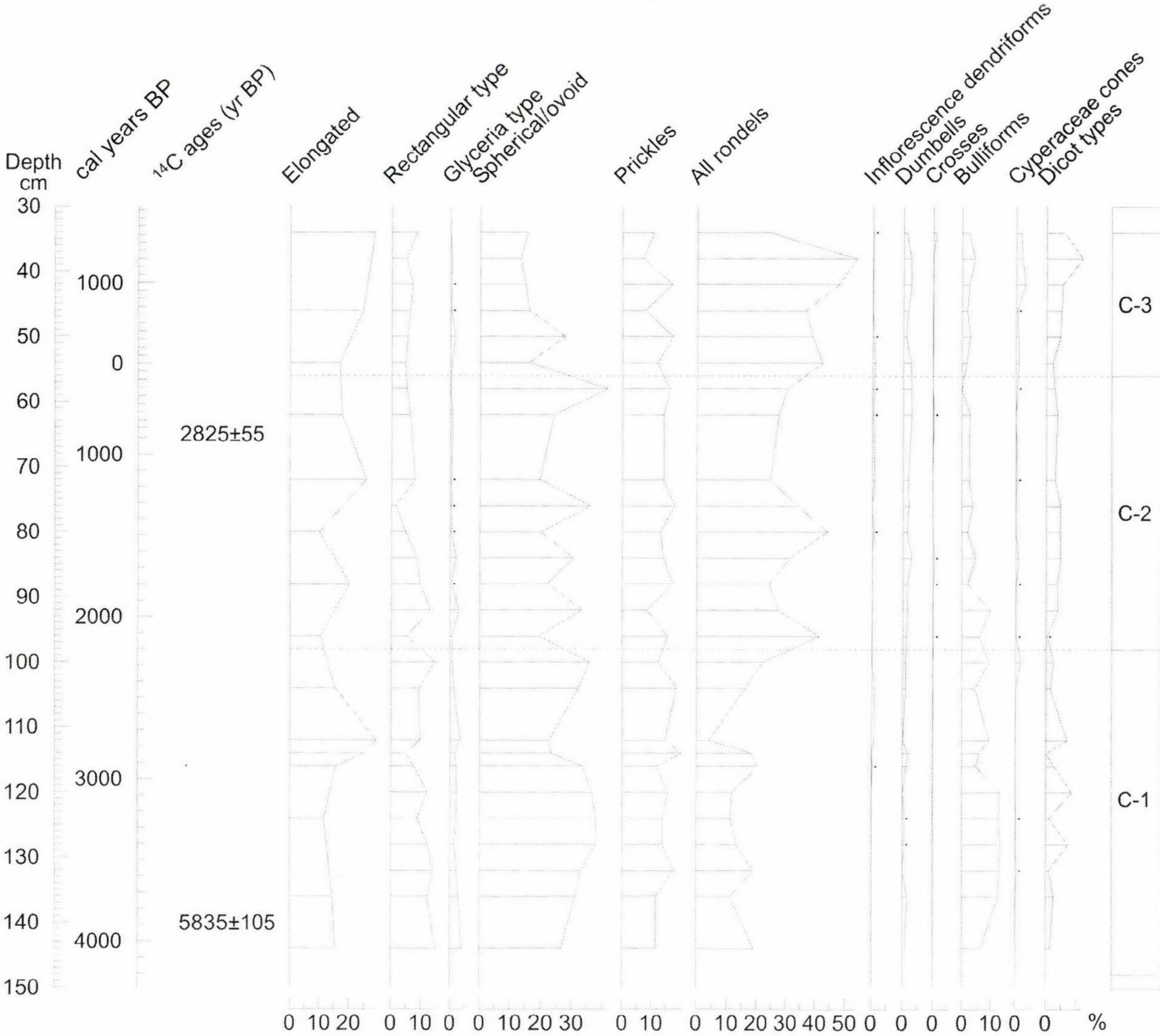


Fig. 7.4. Phytolith types and abundances in Core 2

A number of morphologies of rondel shape were seen in both cores all small, with round to oval flat bases, forming tapering cones of various heights, with flat tops or ridges. Some were slender, some more robust, usually with a central cavity. They were present in all samples, and at the top of Core 2 in great abundance, forming up to 50% of the total phytolith community. Similar phytoliths were seen in most of the modern grass specimens examined, in variable quantities *(Fig. 7.1)*, but most particularly in modern specimens of *Phragmites* in both leaf and inflorescence *(Fig. 7.1)* where they occurred in massed ranks in all specimens in great abundance. It is thought possible that the abundances of such phytoliths seen in the Core 2 samples especially at higher levels may be positively correlated with the abundance of *Phragmites* in the plant community at the time, as that particular species may represent such a large input to that particular phytolith population that any signal from this phytolith type contributed by other grasses would be swamped by the input from *Phragmites* when it was present. Further, *Phragmites* is a very abundant species in the Kiri-tó today and may well have been so ever since environmental conditions became suitable for it.

A few dumbell shaped phytoliths were observed in most samples. Dumbells are recorded from both Panicoid and Festucoid grasses, but the proportions are usually different. The dumbbells seen in the Kiri-tó cores were mostly bilobate (rather than trilobate), which may be more characteristic of Panicoid grasses (Mulholland and Rapp 1992), but the shank of the dumbbell was about two-thirds to three quarters of the width of the lobe, which is more characteristic of Festucoids (Mulholland and Rapp 1992). No conclusions are drawn as to the provenance of these phytoliths.

Bulliform cells (sometimes called 'motor cells'), both fan and shield shapes, also seen in all samples, are not characteristic of any particular group of grasses but their development and silicification may be positively correlated to wetness of environment (Sangster and Parry 1969). These phytoliths are most abundant in the lower levels of Core 1.

In both cores a small percentage (less than 5%) of phytoliths of irregular or jigsaw shape thought to come from dicotyledonous species occurred at all levels. There were also a number of unknown phytoliths of shapes not typical of dicotyledonous types, and a number too corroded to be confidently assigned to any group.

Two phytolith types were seen in one core but not the other. Although both cores contained smooth surfaced ball and egg shaped phytoliths typical of Festucoids, ball shaped phytoliths with a rugulose surface more consistent with types reported from dicotyledonous species (Barboni *et al.* 1999) were recorded only from Core 1. Conversely, hat-shaped phytoliths typical of Cyperaceae were recorded only from Core 2.

Discussion

Core 1

The lowest levels analysed from this core date from the early part of the Körös occupation and the sequence continues beyond the dates studied in the archaeological sequence. It is very noticeable that the relative abundances of the various types of phytolith in this core changes little throughout the sequence, suggesting there was in the immediate locality little environmental change, whether climatic or anthropogenic. The phytolith community suggests an area of Festucoid grassland, possibly with a small input from nearby dicotyledonous plant species. The presence of B1 and rondel type phytoliths at a steady abundance at all levels may well imply that the immediate site of the core remained always within a constant gradient of dampness from the edge of the oxbow or that it was regularly flooded so that wetland plant material from up or down the gradient was carried into the immediate area. B1 and rondel types appear to coexist at each depth. Assuming that the phytoliths are indeed representative of the abundances of the two species as suggested in Section 2.2, *Phragmites* and *Glyceria* would be expected to compete when growing together, through both interspecific competition (each probably with the ability to suppress the other once having a slight advantage) and through slightly different responses to local environmental variation (Buttery and Lambert 1965). Here there is no clear indication of the abundance of one changing in reaction to the other, suggesting little change in the local gradient through the time period of Core 1, and supporting the evidence (see Willis, chapter 6) that the date of the ox-bow cut-off predates the sedimentary sequence. The proportion of bulliform phytoliths seen also remains rather constant throughout the sequence at between 6% and 10%, perhaps further indicating little change in overall dampness of the site *(Fig. 7.5).*

The presence of B1 phytoliths, if indeed indicative of *Glyceria*, throughout the core may help explain why cereal pollen apparently occurs oddly early (at about 11,000 BP) in the pollen sequence, before the arrival of the Körös people. *Glyceria* pollen is very like that of *Hordeum,* and the small amount of such pollen seen then in this core may therefore actually be *Glyceria* pollen. The larger amounts of cereal pollen counted at the times/depths when the Körös people

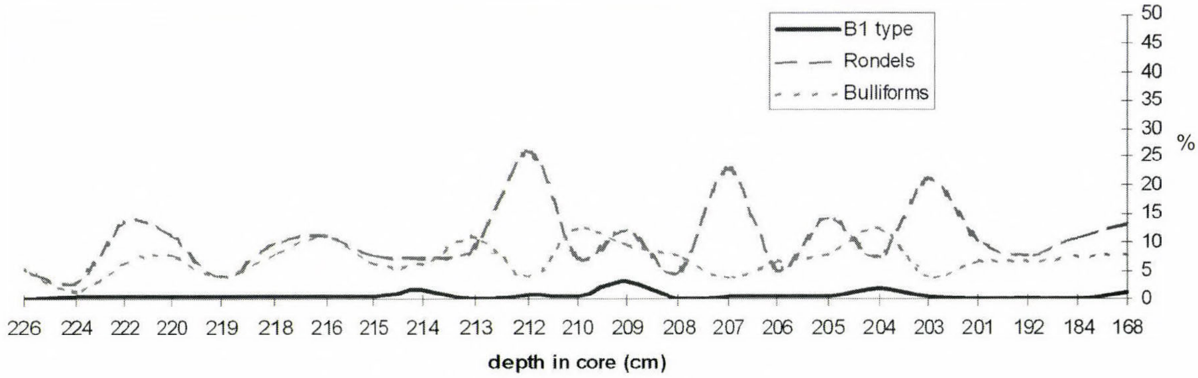


Fig. 7.5. Percentages of certain phytoliths in Core 1

were present locally are confirmed to be from cereals by residues of both *Hordeum* and *Triticum* found on the actual occupation site (see Madella, chapter 24), and the presence of cereal residues on-site reinforces the likelihood that the occasional dendriform phytoliths seen in these cores are cereal in origin.

Core 2

The lowest depth analysed in Core 2 dates from about 4000 cal BC. In the lower part of this phytolith sequence, the impression of a damp rather unchanging environment as interpreted from Core 1 is confirmed. Evidence of drying of the environment is seen however after about 2800 cal BC, as evidenced by a gradual change in the balance of the phytolith community, with the increase in abundance of rondel phytoliths, fewer of the B1 type, and a smaller proportion of bulliform phytoliths in each sample *(Fig. 7.6)*.

In a drying sequence *Phragmites* would be expected to take over from *Glyceria*, as it is thought to be more tolerant of conditions unfavourable to both species (Buttery and Lambert 1965), and is usually seen further back from the water's edge in waterside communities. The reduction in the proportion of bulliform phytoliths reinforces the suggestion of a drying in the environment, and an increase in the abundance of non-wetland grasses would further contribute to the increase in the abundance of rondel types.

This, taken alongside the pollen record for Core 2 (unpublished), which shows a steady increase in pollen from weeds and plants of disturbed ground from this date, suggests that there began about 2800 cal BC a drying sequence in the immediate vicinity. The new drier community, once established, continued at least up to about 1500 cal AD at the top of the sequence studied.

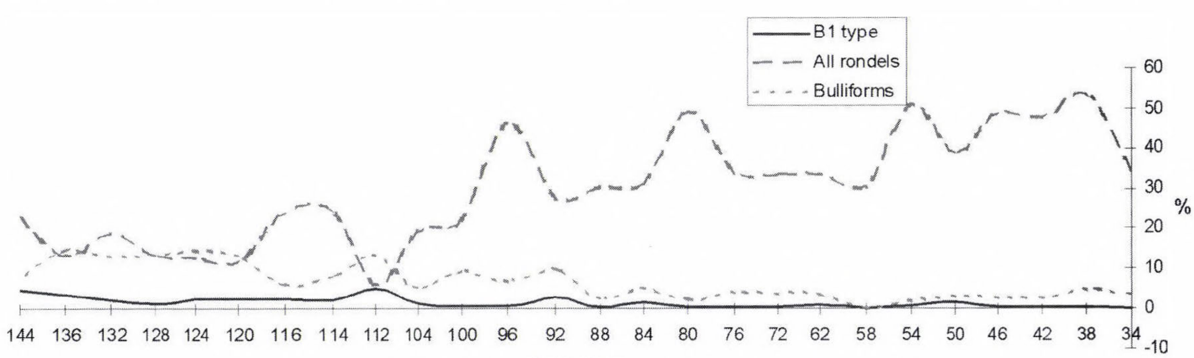


Fig. 7.6. Percentages of certain phytoliths in Core 2

Dicotyledonous phytoliths from both cores

At every level in both cores there was a small input of unknown phytoliths probably of dicotyledonous origin. Although the numbers are small these phytoliths may be representative of a greater abundance of dicotyledonous species in the immediate environment as dicotyledonous phytoliths are produced in much less abundance than those from grasses (Albert and Weiner 2001) so that their signal is easily swamped. Tree pollen is found at all levels in both of the cores, but it is not known how close by the 'open parkland' suggested by pollen studies in the locality grew. Although Fredlund and Teiszen (1994) demonstrated a considerable extra-local input of phytoliths in dry grassland sites, Rovner (2000), working in a wetland margin, showed that very local deposition of phytoliths could be used to distinguish sites close to each other and apparently ecologically similar. Where stands of tall grasses restrict the flow of debris carried in water, it can perhaps be assumed that a great proportion of the phytoliths found here are of very local origin. It is possible then, that the small numbers of dicotyledonous phytoliths present are also of very local origin, and the input of dicotyledonous phytoliths probably from dung found on the archaeological site (mainly from Trench 23B: Madella, chapter 24) below of very local origin also.

Conclusions

The results from the phytolith analysis from these two cores in general support the findings from the pollen analysis (Willis, chapter 6) that throughout the period of the Körös culture occupation and for some time after the local environment of the Kiri-tó remained very stable and there is little or no evidence of environmental impact caused by the Körös culture. However, the phytoliths do also give hints of further questions to be addressed. At the present time, the immediate environs of the Kiri-tó contain large stands of *Phragmites* reeds, but the phytolith sequence seen in Core 2 may imply that the dominance of such species was less when the Körös people were there and that species tolerant only of wetter conditions were then more abundant. Was the immediate environment in the Bronze Age analogous to that seen now, or was it then somewhat wetter and maybe rather more diverse? If the environs of the Kiri-tó were open parkland in 3000 cal BC rather than the extensive grassland seen today, was the change from open parkland to open grassland brought about by anthropogenic factors, or was it a climatic trend that began soon after 2800 cal BC?

To assist in addressing these questions, work is therefore continuing to identify some of the unknown, probably dicotyledonous, phytoliths seen in the cores, particularly in Core 1, perhaps correlating with types found on-site (as reported by Madella, chapter 24).

Chapter 8

MOLLUSC-BASED ENVIRONMENTAL RECONSTRUCTION AROUND THE AREA OF THE KIRI-TÓ

Pál Sümegi

Initially, two cross-sections were chosen for sampling the Kiri-tó (see Sümegi and Molnár, chapter 5) on the basis of the initial probe corings, but because of the low specimen numbers of the molluscs and the breaking of the Russian core bit during the sampling of the profile chosen for pollen analysis, a pit was dug by hand along this latter profile to take molluscan samples. Samples were taken from this pit at 10 cm intervals, yielding a total amount of 10.8 kg (4 dm^3) sediment. The samples were sieved through a mesh of 0.5 mm to retain the mollusc shells. Some adjacent samples, where the number of specimens was below 100, were drawn together, and in those cases the molluscan fauna was analysed and presented at a 20 cm interval *(Table 8.1; Figs 8.1–2)*. The surface of the shells had suffered intensive chemical corrosion and a large number of molluscs have come to light in the forms of pseudomorphs lacking the actual shell.

For the classification of the material into paleoecological groups, the works of Boycott (1934), Sparks (1961), Ant (1963), Ložek (1964), Evans (1972) and Meijer (1985) have been used along with the distributional data and maps of Ehrmann (1933), Soós (1943), Liharev and Rammel'meier (1962), Ložek (1964), Bába (1983a; 1983b; 1986) and Kerney *et al.* (1983). The presence, absence or dominance of the individual species or the certain paleoecological groups served as a basis for drawing conclusions about paleoenvironmental conditions.

The dominance values of certain mollusc species, and those of the given paleoecological groups, are of crucial importance regarding the reconstruction of the prevailing environmental factors. Dominance values are based on the calculation of percentages from the specimen numbers of species collected from the sample (Sparks 1961; Ložek 1964; Krolopp 1965; 1973; 1983). However, as there are significant size differences between the shells of mollusc species present in a given volume or unit sediment sample (in our case 1 dm^3), some of them being only a couple of mm while others a couple of cm high or wide, the percentages of smaller specimens and consequently their 'chance of occurrence' in the unit sample is a lot more probable than those of the larger specimens (Krolopp 1967). In order to avoid this effect, the Harlow index has been calculated, as frequently used in modern malacological investigations (Szabó 1990). This index cancels out size differences by taking into account the values of shell height and width of the specimens under examination, besides their percentages. The Harlow index is calculated with the following formula: H index = the percentage value of a given mollusc species present in the sample *x* the average height of the shells *x* the average width of the shells.

Thus through the determination of the H index, one can get a more precise and sophisticated view of the prevailing conditions, including taphonomic processes and factors. Its application also enables the accurate determination of the dominant species in the sample (Sümegi 2003b).

The distribution of the individual species, paleoecological and biogeographical groups within the profile according to the sampling depths were depicted on graphs prepared by the Psimpoll software pack of Bennett (1992). The Quaternary molluscs have been used to discriminate between individual paleoecological zones. Podani (1978; 1980) presented several classification and

Table 8.1. Mollusc fauna from the Kiri-tó core sequence

Species/depth in metres	0,2–0,4		0,4–0,6		0,6–0,8		0,8–1,0		1,0–1,2		1,2–1,4	
	db	%	db	%	db	%	db	%	db	%	db	%
Valvata cristata	**35**	30.43	**102**	53.68	**75**	43.86	**67**	43.8	**64**	41	**35**	25.5
Valvata pulchella	**0**	**0**	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Viviparus contectus	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.64	**2**	1.46
Lymnaea stagnalis	**0**	0	**0**	0	**1**	0.585	**3**	1.96	**5**	3.21	**6**	4.38
Lymnaea palustris	**1**	0.87	**4**	2.105	**5**	2.924	**5**	3.27	**5**	3.21	**7**	5.11
Lymnaea truncatula	**3**	2.609	**5**	2.632	**3**	1.754	**3**	1.96	**1**	0.64	**0**	0
Bithynia leachi	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Bithynia tentaculata	**0**	0	**1**	0.526	**4**	2.339	**5**	3.27	**6**	3.85	**11**	8.03
Planorbarius corneus	**1**	0.87	**1**	0.526	**3**	1.754	**4**	2.61	**5**	3.21	**9**	6.57
Planorbis planorbis	**1**	0.87	**2**	1.053	**4**	2.339	**4**	2.61	**5**	3.21	**9**	6.57
Anisus spirorbis	**3**	2.609	**4**	2.105	**5**	2.924	**5**	3.27	**6**	3.85	**2**	1.46
Anisus leucostoma	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Anisus septemgyralus	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Anisus vorticulus	**1**	0.87	**2**	1.053	**2**	1.17	**1**	0.65	**2**	1.28	**4**	2.92
Acrolocus lacustris	**3**	2.609	**5**	2.632	**5**	2.924	**4**	2.61	**5**	3.21	**2**	1.46
Gyraulus albus	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**2**	1.46
Gyraulus laevis	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Armiger crista	**5**	4.348	**6**	3.158	**6**	3.509	**5**	3.27	**6**	3.85	**7**	5.11
Segmentina nitida	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.73
Pisidium sp.	**19**	16.52	**17**	8.947	**15**	8.772	**14**	9.15	**17**	10.9	**21**	15.3
Carychium minimum	**19**	16.52	**15**	7.895	**15**	8.772	**12**	7.84	**8**	5.13	**4**	2.92
Succinea oblonga	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.64	**1**	0.73
Succinea putris	**4**	3.478	**5**	2.632	**5**	2.924	**4**	2.61	**4**	2.56	**2**	1.46
Oxyloma elegans	**5**	4.348	**6**	3.158	**5**	2.924	**3**	1.96	**3**	1.92	**2**	1.46
Vertigo angustior	**1**	0.87	**1**	0.526	**1**	0.585	**0**	0	**0**	0	**0**	0
Vallonia pulchella	**2**	1.739	**2**	1.053	**3**	1.754	**2**	1.31	**1**	0.64	**1**	0.73
Limacidae	**2**	1.739	**3**	1.579	**4**	2.339	**5**	3.27	**3**	1.92	**1**	0.73
Zoniotides nitidus	**5**	4.348	**6**	3.158	**5**	2.924	**4**	2.61	**2**	1.28	**1**	0.73
Euconulus fulvus	**1**	0.87	**2**	1.053	**2**	1.17	**1**	0.65	**1**	0.64	**1**	0.73
Perforatella rubiginosa	**3**	2.609	**1**	0.526	**2**	1.17	**1**	0.65	**1**	0.64	**1**	0.73
Bradybaena fruticum	**0**	0	**0**	0	**1**	0.585	**1**	0.65	**1**	0.64	**1**	0.73
Monacha cartusiana	**1**	0.87	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Helix pomatia	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.64	**1**	0.73
Unio pictorum	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.64	**2**	1.46
Unio tumidus	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Unio sp.	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0.64	**1**	0.73
Total	**115**	100	**190**	100	**171**	100	**153**	100	**156**	100	**137**	100

ordination methods, which he considered suitable for the comparison of molluscan faunas. From these we used the Sørensen index modified by Bray and Curtis (Southwood 1978; cf. Molnár and Sümegi 1990; 1992) dealing with the analysis of Quaternary molluscs. One of the major advantages of the use of this index lies in the fact that it takes into consideration differences in species dominance per sample. As the data used was in the percentage format there was no need for any standardization (Birks 1986). Similarity analyses were carried out in accordance with

Table 8.1. Continued

1,4–1,5		1,5–1,6		1,6–1,7		1,7–1,8		1,8–1,9		1,9–2,0		2,0–2,1		2,1–2,2	
db	%	db	%	db	%	db	%	db	%	db	%	db	%	db	%
27	17.9	12	9.52	4	3.57	4	3.7	2	1.87	1	0.94	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0.94	1	0.93	3	2.54
4	2.65	4	3.17	2	1.79	2	1.85	0	0	0	0	0	0	0	0
11	7.28	10	7.94	9	8.04	12	11.1	14	13.1	14	13.2	12	11.2	14	11.9
14	9.27	11	8.73	9	8.04	8	7.41	6	5.61	4	3.77	5	4.67	6	5.08
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0.93	5	4.67	11	10.4	14	13.1	12	10.2
12	7.95	11	8.73	12	10.7	11	10.2	9	8.41	3	2.83	1	0.93	0	0
11	7.28	10	7.94	16	14.3	14	13	14	13.1	12	11.3	14	13.1	12	10.2
15	9.93	12	9.52	15	13.4	17	15.7	19	17.8	17	16	15	14	15	12.7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0.94	4	3.74	6	5.08
0	0	0	0	0	0	1	0.93	4	3.74	5	4.72	7	6.54	5	4.24
2	1.32	1	0.79	1	0.89	1	0.93	0	0	0	0	0	0	0	0
1	0.66	1	0.79	0	0	0	0	0	0	0	0	0	0	0	0
3	1.99	3	2.38	3	2.68	2	1.85	2	1.87	0	0	0	0	0	0
0	0	0	0	0	0	1	0.93	2	1.87	4	3.77	3	2.8	5	4.24
3	1.99	2	1.59	2	1.79	2	1.85	3	2.8	3	2.83	3	2.8	4	3.39
1	0.66	1	0.79	1	0.89	2	1.85	1	0.93	3	2.83	2	1.87	3	2.54
19	12.6	19	15.1	21	18.8	22	20.4	24	22.4	25	23.6	25	23.4	31	26.3
5	3.31	3	2.38	1	0.89	0	0	0	0	0	0	0	0	0	0
1	0.66	1	0.79	0	0	1	0.93	0	0	0	0	0	0	0	0
2	1.32	2	1.59	0	0	0	0	0	0	0	0	0	0	0	0
1	0.66	1	0.79	1	0.89	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1.99	3	2.38	1	0.89	1	0.93	0	0	0	0	0	0	0	0
5	3.31	5	3.97	2	1.79	1	0.93	0	0	0	0	0	0	0	0
2	1.32	1	0.79	0	0	0	0	0	0	0	0	0	0	0	0
1	0.66	1	0.79	1	0.89	0	0	0	0	0	0	0	0	0	0
1	0.66	1	0.79	1	0.89	0	0	0	0	0	0	0	0	0	0
1	0.66	3	2.38	2	1.79	1	0.93	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1.32	1	0.79	1	0.89	0	0	0	0	0	0	0	0	0	0
2	1.32	4	3.17	3	2.68	2	1.85	1	0.93	0	0	0	0	0	0
1	0.66	2	1.59	3	2.68	1	0.93	0	0	0	0	0	0	0	0
1	0.66	1	0.79	1	0.89	1	0.93	1	0.93	2	1.89	1	0.93	2	1.69
151	100	126	100	112	100	108	100	107	100	106	100	107	100	118	100

Podani's advice (1978; 1980), followed by the grouping method of Bray and Curtis (Southwood 1978) using Orlóci and Ward-type clustering utilizing the NUCOSA statistical software package of Tótmérész (1993). The resulting clusters on the dendrogam were taken to represent a palaeobiological zone (Molnár and Sümegi 1990; 1992).

Besides the molluscan samples taken from the cross-sections deepened in the channel of the Kiri-tó, the shells which came to light via wet sieving or selection from the archaeological trenches

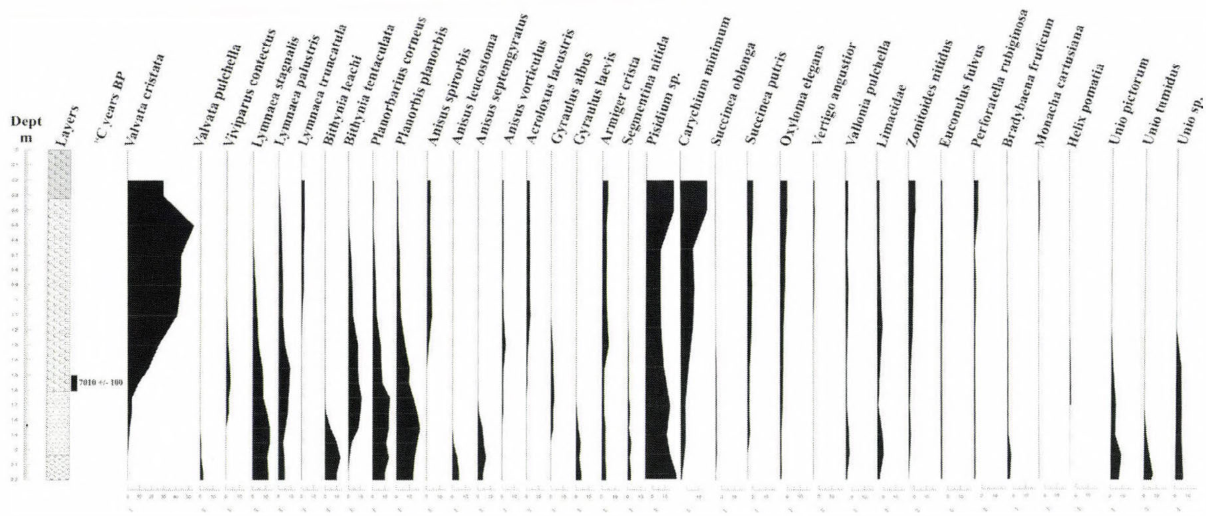


Fig. 8.1. Dominance of mollusc species from the Kiri-tó sequence

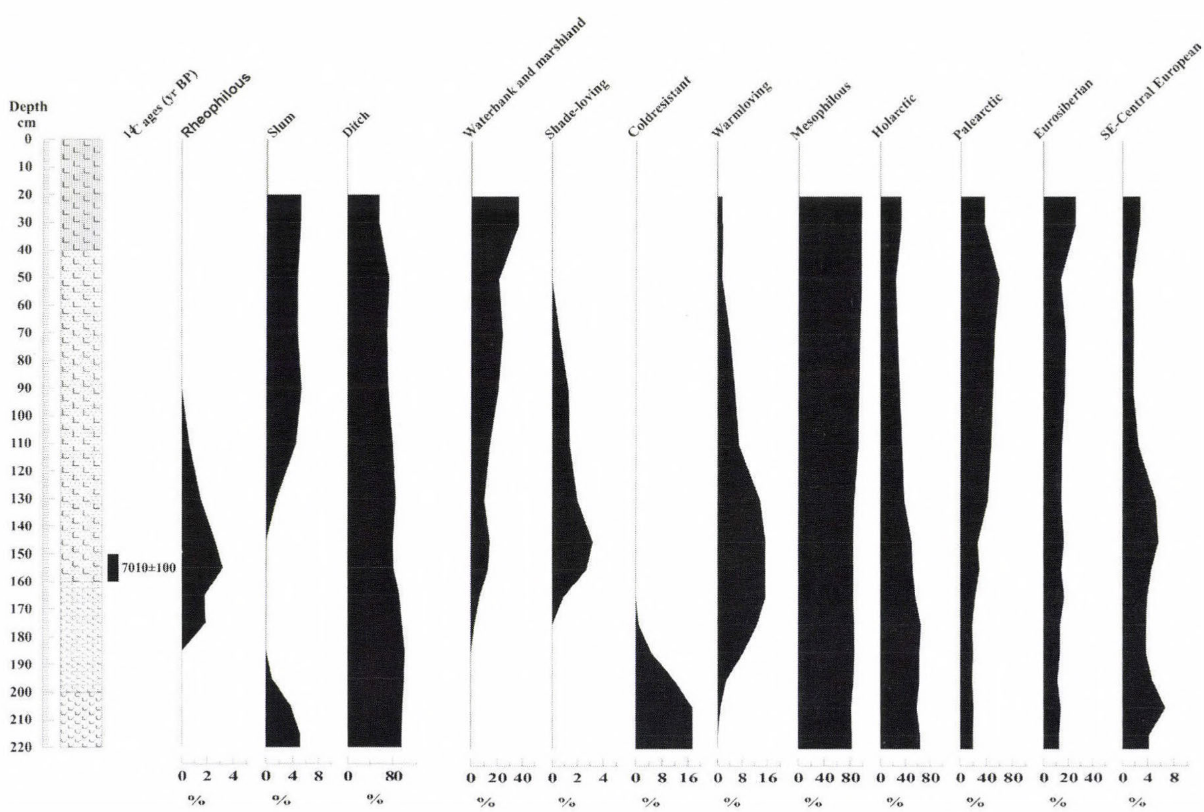


Fig. 8.2. Dominance of the palaeoecological groups from the Kiri-tó sequence

on Ecsegfalva 23 were also investigated. The results of the analysis of this latter malacofauna is presented in a separate chapter on shellfishing (Gulyás *et al.*, chapter 21), as the majority of the shells must have been intentionally collected by humans, and are thus preserved in the archaeological layers as a result of human activities (Evans 1972; Evans and O'Connor 1999).

Results of the analysis of mollusc samples taken from the cross-sections of the channel of the Kiri-tó

From the lacustrine deposits of the No. 1 malacological profile of the Kiri-tó, 1857 mollusc specimens were collected belonging to 35 different species. According to the results of the statistical analyses, four major malacological horizons representing four different developmental stages of the former aquatic habitat could be inferred. The first malacological horizon is located between the depth of 2.2–2.0 m. Only species requiring permanent water coverage have come to light from this zone. According to the composition of the malacofauna, a 2–3 m deep, clear lake must have developed in the channel of the Kiri-tó at the time of deposition of this material, with cold waters even during the growth season. Of the thermophylous elements which started to spread during the Holocene, the only so-called warm taxon present, in small numbers, is *Bithynia tentaculata*. On the other hand, the ratio of cold-resistant forms was the highest in this horizon within the whole profile, and the cold-resistant species, which had undergone a retreat at the end of the Pleistocene and beginning of the Holocene in the Carpathian Basin like *Valvata pulchella* and *Bithynia leachi*, were present only in this horizon. The dominance of Holarctic and Palearctic species characterises the malacofauna within this level, but the ratio of Euro-Siberian and Boreal elements was also quite significant.

According to the findings of malacological analysis of Hungarian radiocarbon-dated profiles this 'mixed' fauna must have developed around 12,000–9000 BP in the centre of the Carpathian Basin, at the end of the Pleistocene and beginning of the Holocene (Sümegi 1989; Sümegi and Krolopp 1995). This mixed faunal horizon, containing both elements, those which started expanding at the beginning of the Holocene and those which went extinct at the end of the Pleistocene and characterised by a dominance of *Valvata pulchella* must have developed between 11–10,000 BC, and was observed in the base level of the floodplain deposits of the Mesolithic locality of Szekszárd-Palánk (10,700 BC: Krolopp 1962), that of the Mesolithic locality of Jászberény-Káplár-tanya (10,500 BC: Sümegi 2003a; 2003b), and the end-Pleistocene lacustrine deposits of Bátorliget marshland (10,500 BC: Sümegi 2003b), and the Fehér lake of Kardoskút (10,600 BC: Sümegi *et al.* 1999). In other words this horizon in the pilot area corresponds to the end of the Epipaleolithic preceding the emergence of the Neolithic and the settling of the first Neolithic farmers by several thousand years.

From a depth of 2 m the cold-resistant species like *Valvata pulchella* and *Bithynia leachi* became restricted in the profile, accompanied by the appearance and increase of thermophylous elements which started spreading during the Holocene like *Viviparus contectus*, *B. tentaculata*, and the forms preferring organic-rich waters like *Lymnaea palustris*, *Planorbarius corneus* and *Planorbis planorbis*. While the species requiring permanent water coverage remain dominant, the composition of the fauna was gradually transformed, representing the community of a shallow, 1.5–2 m deep, organic-rich, lake with water temperatures exceeding 20°C during the growth season.

According to the composition of the fauna a shallow, organic-rich lake with waters experiencing rapid warming during the growth season must have developed in the area at the beginning of the Holocene, preceding the emergence of the Neolithic. This oxbow-lake must have been characterised by non-alkalic, well-oxygenated waters and must have harboured a bivalve infauna and epifauna. This second malacological horizon is located between the depths of 2.0–1.6 m and corresponds to a period of the Early Holocene lasting down to the settlement of the Early Neolithic groups.

There is a significant transformation in the malacofauna between the depths of 1.6–1.5 m, with a sudden increase in the ratio of elements preferring waters with floating plant coverage (*Valvata cristata, Acroloxus lacustris, Armiger crista*) and the appearance of landsnails and lit-

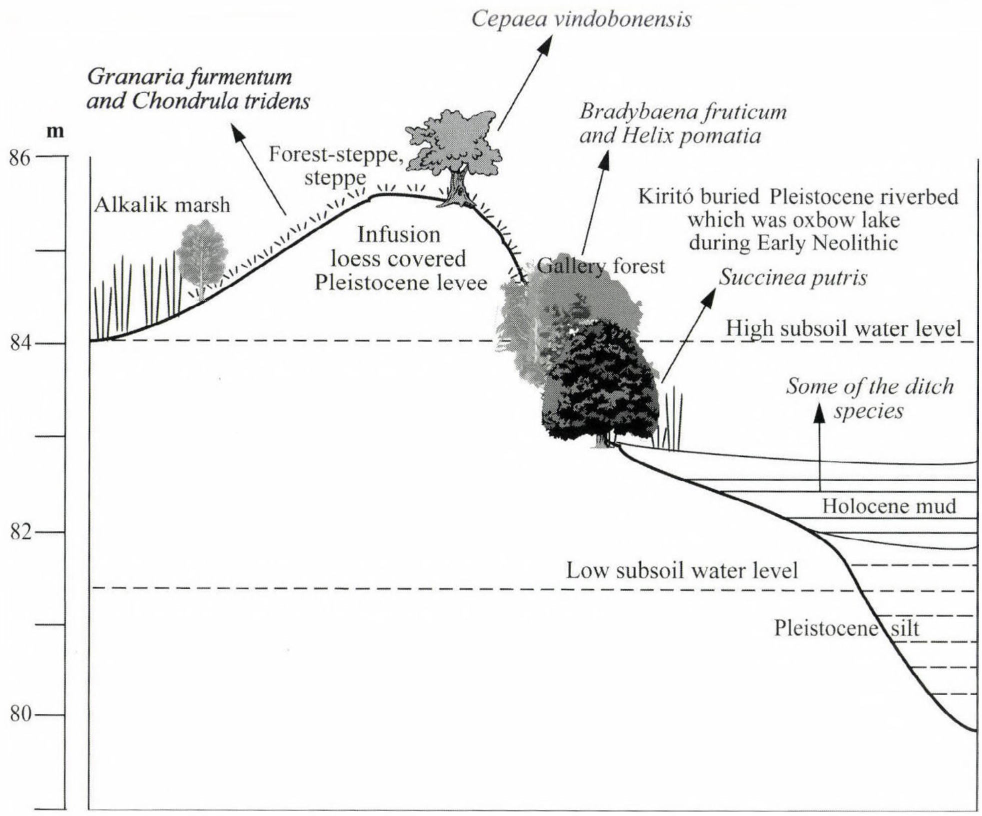


Fig. 8.3. Mollusc-based environmental reconstruction around the area of the Kiri-tó during Early Neolithic Age

toral forms (*Succinea putris, Oxyloma elegans, Carychium minimum*) within the profile. According to these alterations a rapid eutrophization must have taken place within the bed of the Kiri-tó resulting in the emergence of an organic-rich, lake with fluctuating water coverage and a maximum depth of 1.5 m. The appearance of the species *Lymnaea truncatula* and *Anisus spirorbis*, which tolerate alkaline waters, indicates a slight alkalization of the lake.

According to the radiocarbon dates (from shells of *Planorbarius corneus*: 7400±70 BP: 6362–6270 cal BC (Deb-7870), and from the hypostracum of *Unio pictorum*: 7010±100 BP: 5979–5798 cal BC (Deb-7855), this malacological horizon must have developed between 6300–5800 cal BC, corresponding to the Early Neolithic and the time of first settlement of Neolithic agricultural groups.

This shallow, alkaline lake must have been present in the study area from the beginning of the Neolithic. However, as the gradual transformation of the fauna, observable in the increase of the ratio of hygrophilous, littoral elements which tolerate temporary water coverage, indicates *(Fig. 8.2)*, the continous erosion of the surrounding areas and the silting-up of the lacustrine system must have continued after the Neolithic as well.

Between the depths of 1.5–0.2 m a gradual increase can be observed in the ratio of *Valvata cristata*, which prefers eutrophic waters with floating plants and higher plant coverage. Furthermore, beside the aquatic elements, the strongly hygrophilous, littoral elements populating the vegetation of the littoral areas (reed, sedge, bulrush) gradually gained significance as well (*Carychium minimum, Succinea oblonga, Succinea putris*). The representatives of species tolerating temporary dessication and alkaline waters like *Anisus spirorbis* also appear in the aquatic fauna. When the changes in the Harlow index referring to possible burial and fossilization *(Fig. 8.1)* are taken together with the values of dominance, it becomes quite apparent that despite the prevalence of *Valvata cristata, Armiger crista* and *Carychium minimum* in the whole horizon, the dominant forms in the aquatic fauna are the larger *Anisus spirorbis*, which tolerates temporary dessication and alkaline waters, and the littoral *Zonitoides nitidus*. According to the molluscan fauna, the waters must have been rather shallow: no deeper than 1 m.

In the area of the Kiri-tó following the Neolithic, there was alternation between an eutrophic lake, gradually becoming alkaline, and a temporarily dessicated swamp. These periodically alternating hydrological stages inferred from the composition of the molluscan fauna seem to represent a mature state of the silting-up of the bed and the transformation of the lacustrine phase into a swamp. Most likely these hydrological conditions must have characterised the area of the Kiri-tó from the fourth millennium cal BC down to the river regulations of the nineteenth century AD.

On the basis of the composition of the molluscan fauna, a gradually silting-up lacustrine system can be inferred in the area from 11,000 BC till 1900 AD.

Summary

According to the analysis of the molluscan fauna of the 2.2 m profile of the Kiri-tó, the accumulation of sediments must have started around in the basin around 12–11,000 BC. A cold-water, oligotrophic lake must have emerged at the end of the Pleistocene, turning gradually into a mesotrophic system at the beginning of the Holocene via gradual eutrophization. This system turned into an alkaline, eutrophic lake from the Early Neolithic. Alternations of a shallow, alkaline lake and alkaline swamp characterised the study area from the end of the Neolithic. The activities of the farming communities in the surroundings of the Kiri-tó must have contributed to the rapid silting-up of the lacustrine system, and the emergence of a swamp to some degree. However, the effects of such influences must have been subordinate in importance compared to natural processes in the area (and see also Willis, chapter 6).

The paleoecological analysis of the molluscan fauna from Ecsegfalva 23

Shell materials collected from three trenches (A, B and C) of the Körös culture archaeological site Ecsegfalva 23 were analysed between 1999 and 2003. Not only the remnants of gathered snails and mussels but also those of the natural mollusc population inhabiting the area could be examined in large numbers *(Tables 8.2–4)*. The composition of the malacofauna is evaluated trench by trench.

Trench 23A

214 specimen of 21 species (seven aquatic, ten landsnails and four bivalves) have come to light from Trench 23A *(Table 8.2)*. Despite this, the proportion of the aquatic fauna is quite significant with a dominance of *Lymnaea stagnalis* and *Planorbarius corneus*. However, species with a preference for moving water like *Lithoglyphus naticoides* and *Valvata piscinalis* have also come to light from the deposits. These faunal elements are not characteristic for the terrestrial deposits exposed during the archaeological excavations nor the former soil horizon. They cannot originate from the floodwaters either, because as the malacological analysis of the Kiri-tó profile revealed, the rheophylic species preferring moving waters could not have existed in the area during the Holocene.

The significant proportion of aquatic species and the presence of rheophylic forms require some sort of explanation. Most likely they must have ended up in the cultural layers of the site as a result of human activities. Necklaces made of the shells of the gastropod *Lithoglyphus nati-*

Table 8.2. Mollusc fauna from Ecsegfalva 23A

Paleoecological group	Mollusc species	i	%	i	%
Moving water loving (Rheophilous) species	*Valvata piscinalis* (Studer, 1820)	1	0.47	**6**	**2.8**
	Lithoglyphus naticoides (C. Pfeiffer, 1828)	2	0.93		
	Unio crassus (Retzius, 1788)	3	1.40		
Stagnant or slowly moving water loving (Ditch) species	*Lymnaea stagnalis* (Linnaeus, 1758)	48	22.43	**100**	**46.74**
	Lymnaea palustris (Müller, 1774)	2	0.93		
	Planorbarius corneus (Linnaeus, 1758)	40	18.69		
	Planorbis planorbis (Linnaeus, 1758)	2	0.93		
	Unio tumidus (Retzius, 1788)	6	2.80		
	Unio pictorum (Linnaeus, 1758)	1	0.47		
	Anodonta sp.	1	0.47		
Periodic water tolerant (Slum) species	*Anisus spirorbis* (Linnaeus, 1758)	6	2.80	**6**	**2.80**
Freshwater Mollusc species	**Freshwater Mollusc species**	**112**	**52.34**	**112**	**52.34**
Freshwater littoral zone loving species	*Succinea putris* (Linnaeus, 1758)	4	1.87	**13**	**6.07**
	Oxyloma elegans (Risso, 1826)	1	0.47		
	Vallonia enniensis (Gredler, 1856)	3	1.40		
	Perforatella rubiginosa (Schmidt, 1853)	2	0.93		
	Zonitoides nitidus (Müller, 1774)	3	1.40		
Shade-loving species	*Bradybaena fruticum* (Müller, 1774)	41	19.16	**42**	**19.63**
	Helix pomatia (Linnaeus, 1758)	1	0.47		
Xerophilous, forest steppe species	*Cepaea vindobonensis* (Férussac, 1821)	34	15.89	**34**	**15.89**
Xerophilous, steppe species	*Chondrula tridens* (Müller, 1774)	11	5.14	**11**	**5.14**
Mesophilous species	*Vallonia pulchella* (Müller, 1774)	2	0.93	**2**	**0.93**
Terrestrial Mollusc species	**Terrestrial Mollusc species**	**102**	**47.66**	**102**	**47.66**
Mollusc species summa	**Mollusc species summa**	**214**	**100.00**	**214**	**100.00**

coides or the bivalve *Unio* have come to light from several Neolithic sites along the River Tisza (Hódmezővásárhely-Gorzsa: Horváth 1982; 1987 and Polgár-Csőszhalom: Raczky *et al.* 1997), showing that these shells were frequently used for the preparation of ornaments by the Neolithic communities (Sümegi 1999a; 1999b; 2003a). However, no signs of ornament preparation were observed on the gastropod shells at Ecsegfalva 23. In my opinion, the minor mollusc shells, not used for consumption, must have been mixed with shells gathered during intensive shellfishing.

According to the findings of the analysis of this fauna, along with those from other trenches (23B and 23C), fishing and shellfishing must not have been restricted to the area of the Kiri-tó but must have significantly relied upon the hydrologically more stable moving waters of the Berettyó located at a distance of 1.5–2 km and its alluvium (and see Bartosiewicz, chapters 20 and Gulyás *et al.*, chapter 21).

Besides the alien, so-called allochtonous species, which must have ended up at the site as a by-product of human gathering, representatives of the local terrestrial, so-called autochtonous mollusk fauna have also come to light. This terrestrial malacofauna was made up of species with highly differing ecological preferences, characterised by the presence of the strongly hygrophilous, littoral *Succineas*, xerophylous *Chondrula tridens*, which inhabits meadows, and the thermophylous and xerophylous *Cepaea vindobonensis*, which inhabits forest steppe regions *(Table 8.2)*. The dominant forms of the terrestrial malacofauna are those of *Bradybaena fruticum* (19%), inhabiting the closed gallery forests of the Great Hungarian Plain with a humid undergrowth, and *Cepaea vindobonensis* (16%), indicating a more arid, forest steppe-steppe environment with high grasses and bearing proportions similar to that of the former species. In my opinion, the terrestrial malacofauna must indicate the presence of a highly mosaic-like complexity in the environment of the study area, It must also indicate differences in vegetation cover, which emerged on top of the fossil river bank in accordance with the altering groundwater levels: a so-called hydroseries, observable in almost all Pleistocene lag-surfaces surviving in the Holocene alluvia of the Tisza valley (Sümegi 2000b; 2003c; Sümegi *et al.* 2002).

Trench 23B

The culture layer of the Körös culture from Trench 23B yielded 3439 specimen of 24 species (eight aquatic and 11 terrestrial snails, five bivalves) *(Table 8.2)*. The number of bivalve shells exceeded 700, giving the opportunity to extend the archaeozoological analysis initiated on bivalve shells from Bronze Age Hungarian profiles (Sümegi 2003c). Similarly to the material of Trench 23A, the dominant forms of the molluscan fauna were *Lymnaea stagnalis* and *Planorbarius corneus*. The size of these shells must be noted here, as a part of the *L. stagnalis* shells had a height over 70 mm, and the largest *Planorbarius corneus* specimens well exceeded the measures of the largest recent forms collected in the Carpathian Basin (Hortobágy: 45 mm: Pintér and Richnovszky 1979), reaching 90 mm. According to the ecological needs of these species observable today in the area of the Great Hungarian Plain (Pintér and Richnovszky 1979), the shallow, organic-rich, slightly alkaline waters of the Kiri-tó and the alluvium of the Berettyó must have offered ideal conditions for the flourishing and rapid growth of these species.

According to the composition of the aquatic fauna, the proportion of species preferring organic-rich, still-waters and eutrophic oxbow lakes was the most significant. However, moving-water species have come to light here as well, as in Trench 23A (*Lithoglyphus naticoides*, *Viviparus acerosus*, *V. contectus*). The presence of these species here seems to confirm the interpretation of Trench 23A, namely that fishing and shell fishing must have taken place not only in the area of the Kiri-tó but alsoin the channel of the Berettyó some 1.5–2.5 km north of the occupation site. The gastropods must have found their way into the containers or vessels used for transportation along with mussels and fish, and their presence in the cultural layer must be attributed to human activity.

The significant proportions of smaller gastropods not suitable for consumption and not used for decoration might also be explained by the use in the Early Neolithic of a special fishing technique without nets or harpoons. According to medieval sources on fishing techniques in Hungary as well as ethnographic analogies, a sophisticated fishing kit or basket was frequently used for trapping fish in the shallow waters of the dead arms or rivers during the summer via pushing the

Table 8.3. Mollusc fauna from Ecsegfalva 23B

Palaeoecological group	Mollusc species	i	%	i	%
Moving water loving (Rheophilous) species	*Lithoglyphus naticoides* (C. Pfeiffer, 1828)	3	0.09	**343**	**10.59**
	Viviparus contectus (Millet, 1813)	1	0.03		
	Viviparus acerosus (Bourguignat,1862)	1	0.03		
	Unio crassus (Retzius, 1788)	338	10.44		
Stagnant water or slowly moving water loving (Ditch) species	*Lymnaea stagnalis* (Linnaeus, 1758)	1121	34.61	**2744**	**84.72**
	Lymnaea palustris (Müller, 1774)	49	1.51		
	Planorbarius corneus (Linnaeus, 1758)	1151	35.54		
	Planorbis planorbis (Linnaeus, 1758)	7	0.22		
	Unio tumidus (Retzius 1788)	154	4.75		
	Unio pictorum (Linnaeus, 1758)	253	7.81		
	Anodonta sp.	7	0.22		
	Pseudanodonta complanata (Rossmässler, 1835)	2	0.06		
Periodic water tolerant (Slum) species	*Anisus spirorbis* (Linnaeus, 1758)	3	0.09	**3**	**0.09**
Freshwater Mollusc species	**Freshwater Mollusc species**	**3090**	**95.40**	**3090**	**95.40**
Freshwater littoral zone loving species	*Succinea putris* (Linnaeus, 1758)	1	0.03	**13**	**0.4**
	Oxyloma elegans (Risso, 1826)	1	0.03		
	Perforatella rubiginosa (Schmidt, 1853)	1	0.03		
	Zonitoides nitidus (Müller, 1774)	10	0.31		
Shade-loving species	*Bradybaena fruticum* (Müller, 1774)	22	0.68	**24**	**0.74**
	Helix pomatia (Linnaeus, 1758)	2	0.06		
Xerophilous, forest-steppe species	*Vallonia costata* (Müller, 1774)	3	0.09	**69**	**2.13**
	Cepaea vindobonensis (Férussac, 1821)	66	2.04		
Xerophilous, steppe species	*Granaria frumentum* (Draparnaud, 1801)	2	0.06	**38**	**1.17**
	Chondrula tridens (Müller, 1774)	36	1.11	**41**	**1.16**
Mesophilous species	*Vallonia pulchella* (Müller, 1774)	5	0.15		
Terrestrial Mollusc species	**Terrestrial Mollusc species**	**149**	**4.60**	**149**	**4.60**
Mollusc species summa	**Mollusc species summa**	**3239**	**100.00**	**3239**	**100.00**

lower open side of the kit against the muddy bottom (a so-called 'feeling technique': Solymos 1957; Szilágyi 1961; Bellon 2003). The basket and trapped fish were very often removed together with the underlying mud layers, resulting in the collection also of gastropods from the bottom.

Besides the large numbers of aquatic fauna, unambiguously the result of human collection from the moving waters of the active bed of the Berettyó a little to the north, a relatively small amount of terrestrial molluscan shells have also come to light *(Table 8.3)*. Part of this terrestrial fauna may represent human gathering, but the smaller species must at any rate have lived on site.

The composition of the terrestrial fauna is very unusual, the product either of mixing through from human gathering or the mosaic-like complexity of the surrounding environment, as the species with different ecological needs have come to light in almost identical proportions from the main archaeological deposits in Trench 23B. Shells of hygrophilous species inhabiting littoral sedges, reeds and bulrushy areas of present-day ponds in the Great Hungarian Plain have been found (*Succineas*, *Zonitoides nitidus, Perforatella rubiginosa*). Besides these elements inhabiting hard- and soft-wood gallery forests (*Bradybaena fruticum, Helix pomatia*), partially shade-loving elements of high-grass steppes and forest-steppes (*Vallonia costata*, *Vallonia pulchella*, *Cepaea vindobonensis*) and those dweling on arid steppes (*Granaria frumentum, Chondrula tridens*) have come to light. In my opinion, the terrestrial malacofauna must refer to the presence of a highly mosaic-like complexity of the environment in the banks of the Kiri-tó, and the differences in a vegetation cover, which had emerged in accordance with the altering groundwater levels: a so-called hydroseries, observable in almost all Pleistocene lag-surfaces surviving in the Holocene alluvia of the Tisza valley today (Sümegi 2000b; 2003c; Sümegi *et al.* 2002).

The wet alluvium must have been inhabited by strongly hygrophilous, littoral species living on the sedges, reeds and bulrushes. The gallery forests, which must have emerged at the interface of the alluvium and the lag-surface, must have harboured forest elements (see also Willis, chapter 6), while the arid steppes, forest steppes covering the uppermost part of the high banks, must have offered a living space for open-area adapted, xerothermophilous species. A similar vegetational zonation and mosaicity, related to the differing soil conditions and groundwater levels with the accompanying molluscan fauna of differing ecological preferences can be observed in several parts of the Great Hungarian Plain today (Nyilas and Sümegi 1991).

Trench 23C

The findings of the analysis of the molluscan fauna of Trench 23C located to the south of the Early Neolithic Körös settlement corroborate this picture. Besides the significant proportions of animal bones, a relatively rich molluscan fauna was excavated from the Early Neolithic layers, almost completely identical in composition with the malacofaunas of the other two trenches *(Table 8.4)*.

The proportions of the species *Lymnaea stagnalis* and *Planorbarius corneus* were dominant among the aquatic species in Trench 23C (85%). On the other hand, only one or two bivalve shells came to light here.

The terrestrial forms were also relatively significant in the molluscan fauna. Here the dominant elements were those which populate water banks like *Zonitoides nitidus*, *Perforatella rubiginosa* and *Vallonia pulchella* and that of *Bradybaena fruticum* which inhabits gallery forests. However, specimens of species of dryer steppe areas like *Cochlicopa lubrica* and *Helicopsis striata*, and of forest steppes like *Cepaea vindobonensis* and *Vallonia costata* have come to light as well. The composition of the terrestrial molluscan fauna of Trench 23C further corroborates the previous assumptions according to which a complex, mosaic-like hydroseries must have emerged in the study area in accordance with the local geomorphological and soil conditions and ground-

Table 8.4. Mollusc fauna from Ecsegfalva 23C

Paleoecological group	Mollusc species	i	%	i	%
Moving water loving (Rheophilous) species	*Valvata piscinalis* (Studer, 1820)	1	0.37	**5**	**1.83**
	Lithoglyphus naticoides (C. Pfeiffer, 1828)	2	0.73		
	Unio crassus (Retzius, 1788)	2	0.73		
Stagnant water or slowly moving water loving (Ditch) species	*Lymnaea palustris* (Müller, 1774)	195	71.43	**239**	**87.55**
	Planorbarius corneus (Linnaeus, 1758)	42	15.38		
	Unio pictorum (Linnaeus, 1758)	1	0.37		
	Anodonta sp.	1	0.37		
Freshwater Mollusc species	**Freshwater Mollusc species**	**244**	**89.38**	**244**	**89.38**
Freshwater littoral zone loving species	*Perforatella rubiginosa* (Schmidt, 1853)	1	0.37	**6**	**2.24**
	Zonitoides nitidus (Müller, 1774)	5	1.83		
Shade loving species	*Bradybaena fruticum* (Müller, 1774)	13	4.76	**13**	**4.76**
Xerophilous, forest-steppe species	*Vallonia costata* (Müller, 1774)	1	0.37	**2**	**0.74**
	Cepaea vindobonensis (Férussac, 1821)	1	0.37		
Xerophilous, steppe species	*Cochlicopa lubricella* (Porro, 1838)	1	0.37	**2**	**0.74**
	Helicopsis striata (Müller, 1774)	1	0.37		
Mesophilous species	*Vallonia pulchella* (Müller, 1774)	5	1.83	**6**	**2.24**
	Nesovitrea hammonis (Ström, 1756)	1	0.37		
Terrestrial Mollusc species	**Terrestrial Mollusc species**	**29**	**10.62**	**29**	**10.62**
Mollusc species summa	**Mollusc species summa**	**273**	**100.00**	**273**	**100.00**

water levels, which is reflected in the following zonation of the malacofauna as well: littoral areas and water banks (Kiri-tó) with strongly hygrophilous species; gallery forests with shade-loving, forest species; river banks, woodland openings and forest-steppe with partial shade-loving species; and patches of steppe with open-area species.

According to the malacothermometric analysis of the terrestrial malacofauna (Sümegi 1989; 1996) the mean July temperatures must have been around 21–22°C during the occupation of Ecsegfalva 23, similar to the conditions observable today.

The molluscan fauna from Ecsegfalva 23: Summary

Significant amounts of mollusc shells were retrieved from the excavation of Ecsegfalva 23. The vast majority of the fauna (bivalves and aquatic species) is by origin alien to the culture layer, and must have been incorporated by human activity. The collection of part of the aquatic fauna must have been intentional, to provide supplementary food source (Sümegi 2003b), while the rest must have got into the culture layer accidentally, as a by-product of shellfishing and fishing. Within the aquatic fauna, the elements inhabiting still or slowly moving, eutrophic, slightly alkaline waters and a muddy substrate were dominant. This former environment is clearly indicated by the giant specimens of *Planorbarius corneus*, exceeding the measures of the present-day forms populating slightly alkaline waters in the Carpathian Basin (such as the Hortobágy).

According to these data, the vast majority of the aquatic fauna must have originated from the Kiri-tó located only about 20–30 m from the settlement. This oxbow lake, which had emerged during the Pleistocene, was a eutrophic and slightly alkaline lacustrine system during the Neolithic. However, the presence of fluvial forms, which prefer moving-water (*Lithoglyphus naticoides, Viviparus, Valvata piscinalis, Unio crassus*), indicates the importance of the channel and floodplain of the Berettyó a short distance from the occupation.

Besides the dominant aquatic fauna the soil horizon yielded shells of a significant terrestrial fauna as well. According to the composition of the terrestrial fauna, a complex, mosaic-like hydroseries must have emerged in the study area in accordance with the local geomorphological and soil conditions and groundwater levels during the Neolithic, enabling the presence of several species with different ecological needs living side-by side *(Fig. 8.3)*.

According to the composition of the malacofauna the following environmental conditions can be inferred for the direct neighbourhood of the archaeological site. The Early Neolithic site was established on top of a Pleistocene lag-surface, which is a fossil river bank. In front of this bank, a shallow, eutrophic slightly alkaline oxbow lake must have existed during the Neolithic with periodically fluctuating water levels and waters no deeper than 1.5 m. A hydroseries must have emerged in accordance with the local geomorphological and soil conditions and groundwater levels made up of the following units moving successively from the shores towards the highest point of the lag surface: a wet reed-sedge-bulrush zone, followed by a zone of gallery forests, forest steppes and steppes. The fluctuating groundwater levels must have contributed to the development of open vegetation units, via initiating alkalization on the infusion-loess covered areas with high carbonate and silica content (Sümegi 1997), preventing the emergence of a woodland vegetation due to edaphic reasons (Sümegi *et al.* 2000).

All these data seem to indicate that the establishment of the Körös culture settlement happened in an open, steppe, forest steppe-like vegetation patch in the uppermost part of the Pleistocene lag-surface, with gallery forests occupying the lower parts and marsh vegetation populating the lake shores *(Fig. 8.3)*. This complexity of the vegetation hydroseries must have influenced the development of soils in the area as well. Thus the environment in which the people of the Körös culture settled here seems to have displayed a mosaic-like patterning on a micro-scale (of a few metres).

Chapter 9

FIELDWORK AND EXCAVATIONS

Alasdair Whittle and *István Zalai-Gaál*
with *Daniela Hofmann* and *Michael A. Hamilton*

Introduction

Alasdair Whittle and *István Zalai-Gaál*

In line with the aims of the project as described above, sample excavations were carried out principally in Ecsegfalva 23, with a little investigation also in site 18 on the inner side of the Kiri-tó. It is important to stress again that these were designed as small-scale sample excavations, with the aims of establishing a detailed history of parts of the site, and of collecting good samples of subsistence residues and other finds. It is also important to stress that Ecsegfalva 23 is not completely intact. It appears to be cut by the drainage channel dug along the south side of the Kiri-tó meander, though this relationship was not examined, and our trenches were deliberately located away from areas of possible disturbance. Towards its north end, the site is overlain by small twin banks, perhaps part of a water system, which pass between Trenches A and B; their construction may have caused some localised disturbance, and excavation trenches were sited away from them too. Finally, while the northern end of the site is protected by deeper overburden (described below in Trench A), the greater part of the site lies today in a large field, which has seen cultivation in recent times, in 1998 for lucerne and 2000 for sunflowers. Sherds, daub and occasional obsidian could be found as surface finds, and were the first indication of the presence of the site in survey by the Hungarian Archaeological Topography in the early 1970s (Ecsedy *et al.* 1982, 80). However, as described below in Trenches B and C, there is no indication of deep ploughing, even though the archaeological deposits lie in places no more than 25 cm below the modern surface.

The map accompanying the first account of the site by the Hungarian Archaeological Topography indicates a site approximately 300 m long (Ecsedy *et al.* 1982, 75, figure). This rather imprecisely records the maximum possible extent of the distribution of finds, unless the area mapped encompasses part of what our own survey (see Hofmann below) showed to be an AVK occupation some 350 m to the south of the highest point of the site 23 levée; that seems unlikely since there is no reference to AVK sherds in the site 23 entry in the Hungarian Archaeological Topography. The combined results of our own surface survey and geophysical survey (see Hamilton below) suggest a maximum extent for Ecsegfalva 23 of some 150 by 70 m, with the geophysical survey in particular indicating the existence of clusters of magnetic anomalies, which strongly suggests that the 'site' was not a single, uninterrupted entity.

The three sample trenches were located to investigate the major differences within Ecsegfalva 23 established by these means. The results of these surveys are first described, then the results of excavation. Full discussion follows in the final chapter of this volume, taking into account the detailed information presented in the chapters following this one.

Surface survey around the Kiri-tó meander

Daniela Hofmann

Aims

During the 2000 season at Ecsegfalva, a dense surface scatter of sherds and daub was located on a slight rise c. 350 m south of Trench 23B *(Fig. 9.1)*. This discovery prompted the surface collection of all pottery, lithics and daub from that rise in an attempt to establish the nature and extent of the site and its relationship to site 23. In addition, the areas around 23B and 23C were also walked to investigate whether the surface scatters coincided with the geophysical anomalies revealed during the 1998 and 1999 seasons (see below). Together, the collected information gives a fuller picture of land use and settlement development in the immediate vicinity of the excavated areas. Grateful thanks are expressed to Krisztián Oross and Tibor Marton for their help and advice.

Method

A grid was set out starting 20 m west and 30 m south from the total station (i.e. beginning on the south-west corner of square CO). From this peg, a baseline running north-south was established. After 200 m, the base line had to be shifted 30 m to the west to avoid the canal. The line then continued for a further 320 m. Along the base line, 20 by 20 m squares were laid out as the standard collection unit. Squares were labeled with a letter/number combination showing their relative position to the baseline *(Figs 9.3–5)*. In the area closer to the excavation, the squares were further subdivided into 10 by 10 m quadrants labeled by square number and the addition NW, NE, SW or SE. The smaller square size was chosen to allow a more detailed comparison with the geophysical data available for this part of the site. From square B5 southwards, where no geophysical data are available, only 20 by 20 m units were walked. This square size provided sufficient resolution to pick up trends in the finds distribution. In each square or quadrant, pottery, daub, knapped stone ('lithics') and grinding stones ('stone') were collected.

Conditions

Generally, conditions were very favourable, as the field had recently been ploughed. Many artefacts were visible on the surface, while the effects of lateral displacement may have been small. Visibility varied with the type of vegetation, the surface in some squares being obscured by vegetation growing very close to the ground. Thick grass prevented survey west of row CC. In most of the field, however, sunflowers dominated, allowing for relatively easy recognition of finds.

Results

The daub collected in each square was weighed, while sherds were weighed and counted. The weights were then converted into a measure of density (weight in grams per square metre) for each square. Most squares showed a density between 0.01 and 3.97 with very few values above 5.95, but extreme densities reached more than 15.88. Daub was patterned in a similar way *(Fig. 9.2)*.

To facilitate the graphical display of this skewed distribution, the values were log transformed and standard deviations from the mean used to provide a first density plot. In general, the rela-

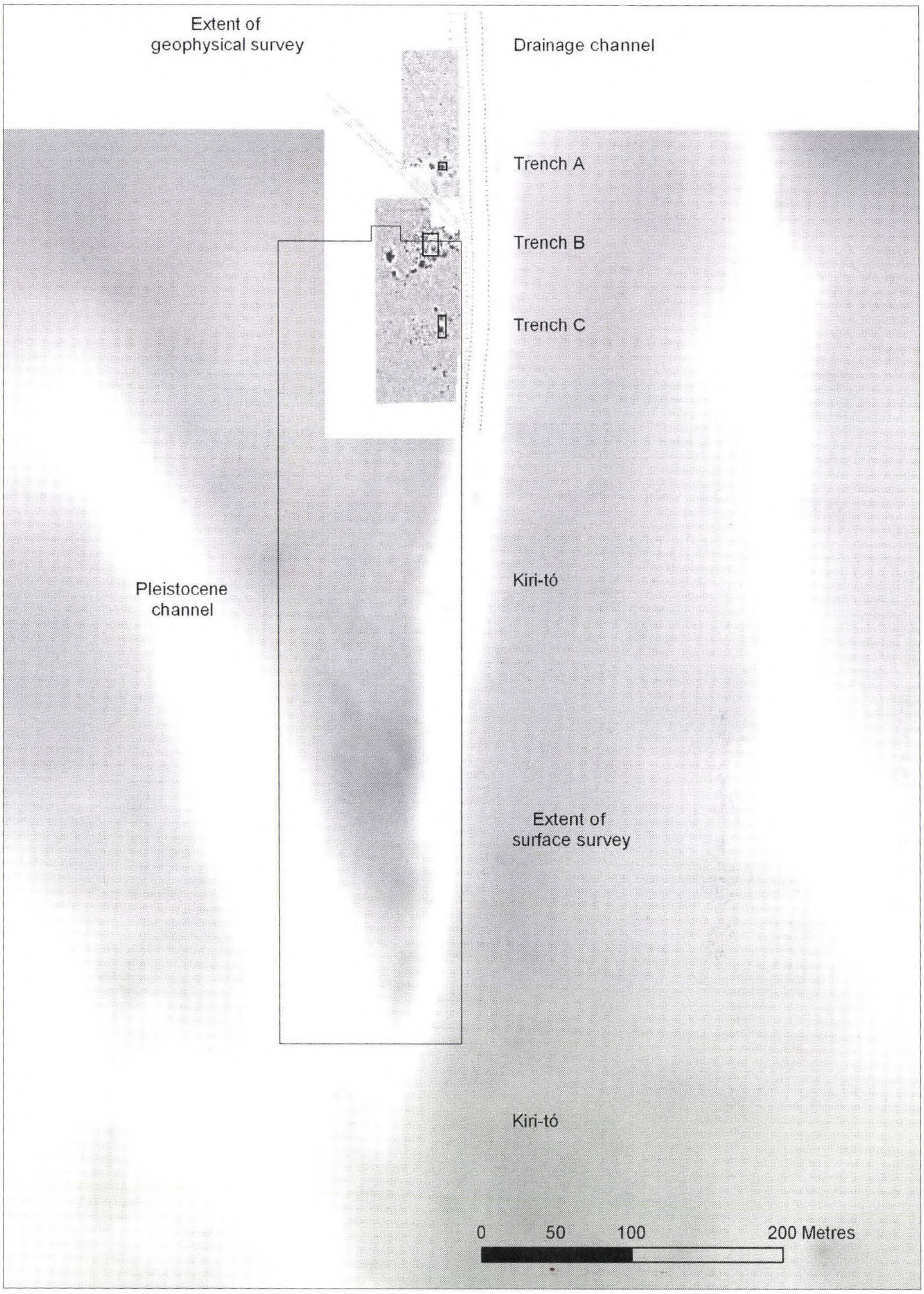
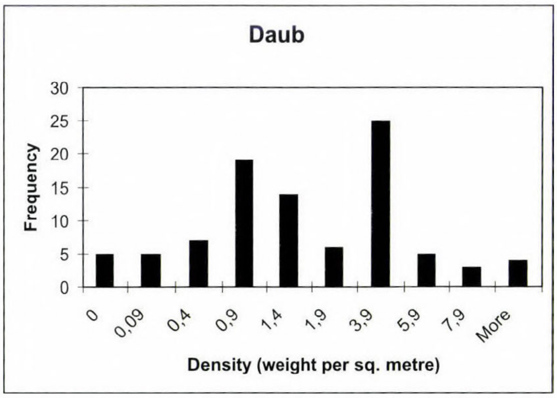


Fig. 9.1. Topographical, geophysical and surface survey around Ecsegfalva 23, with the areas of excavation

tive density of sherds and daub correlates well (rsq 0.61), although some anomalies do exist *(Figs 9.3–4)*. There is, for instance, an inverse relationship of daub to sherd density in square C3. As values cluster in the range between 0.01 and 4.0 and there are only a few extreme values, these could have a disproportionate effect on the standard deviation. Therefore, mean values and interquartile ranges were also calculated to compensate for this effect.



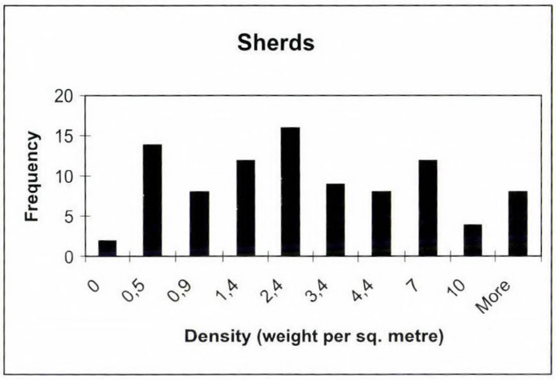


Fig. 9.2. Histograms of daub and sherd density in grams per square metre

However, none of these statistical operations changed the picture fundamentally. The main concentrations of finds were more visible as obvious peaks in the plots based on simple standard deviation as opposed to inter-quartile ranges, but essentially the quality of the information conveyed was the same. Therefore, in the final version we have adopted a simple density measure as it is the most intuitively meaningful variable and an accurate measure of real concentrations of finds.

The most immediately obvious spatial patterning is seen in two areas of higher finds density. The first is in the north of the survey area, especially in the immediate surroundings of Trenches 23 B and 23C (squares B0, B3, C3, C4). The second is centred around square A18 to the south. They are separated by a relatively empty area, although no square was completely devoid of finds. This pattern is also reflected in the distribution of stone artefacts *(Fig. 9.5)*, although they are generally rarer in the northern concentration. This is especially true for grinding stones, of which only one example was found in the north part.

The finds distribution was then integrated with the topographical survey undertaken by Mark Gillings. This showed that the two areas of dense distribution coincide with slightly elevated ground (as pointed out for other Körös culture sites: Kosse 1979, 125). The accumulation of debris then further emphasised the natural topography. Closer inspection of the material revealed that the two rises were the product of two different periods of occupation, and they will hence be considered separately.

Interpretation

The northern concentration

In the northern concentration, all diagnostic sherds belonged to the Körös culture. The relative rarity of lithic material, especially grinding stones, corroborates this and is well in keeping with the general scarcity of lithic material from the excavation. Also, the only three 'netsinkers' were recovered in this area.

The sherd distribution is rather irregular, although more are generally recovered from the areas immediately next to the trenches (B0, B3 E, C3, C4 N) with an area of lesser density between them. This accords well with the pattern of geophysical anomalies on which the siting of the trenches was ultimately based. There are also marked fall-off patterns towards the west of the distribution and south of square C4. Especially in rows 1 and 2, however, no clear pattern is discernible. Squares of higher and lower sherd density alternate without showing obvious clustering.

There are two possible explanations for this. Undoubtedly, human disturbance played a part in producing this pattern. The field camp of the excavation was nearby and both the workforce

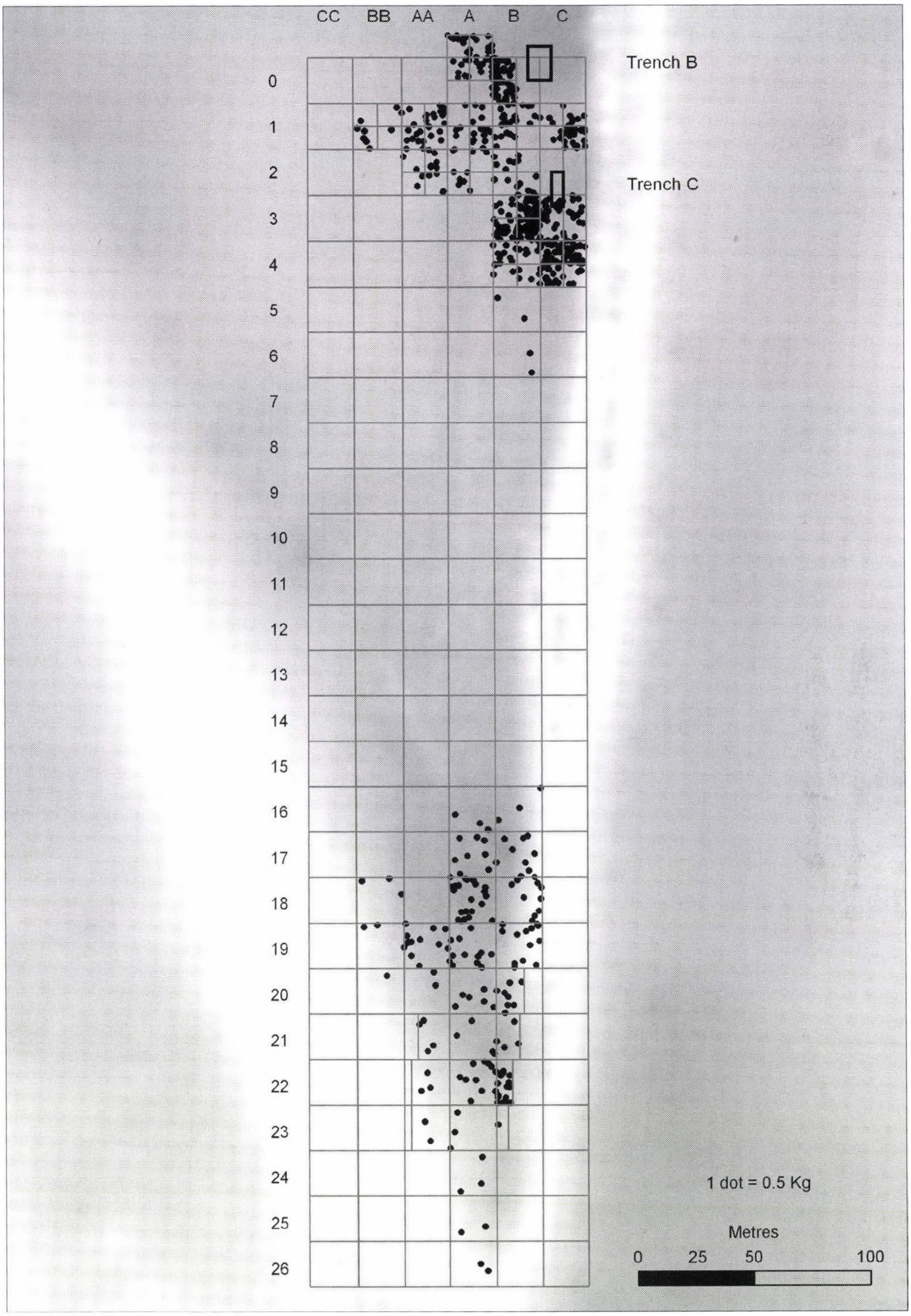


Fig. 9.3. Distribution of sherds in the surface survey

and visitors to the site collected or redistributed sherds on their way to and fro. On a more positive note, the pattern might reflect a true distribution of rubbish pits or activity areas around and beyond the main foci of occupation. Square BB1 SW, for instance, could be a small separate activity area at which pottery was used away from the main site. Separate activity areas are

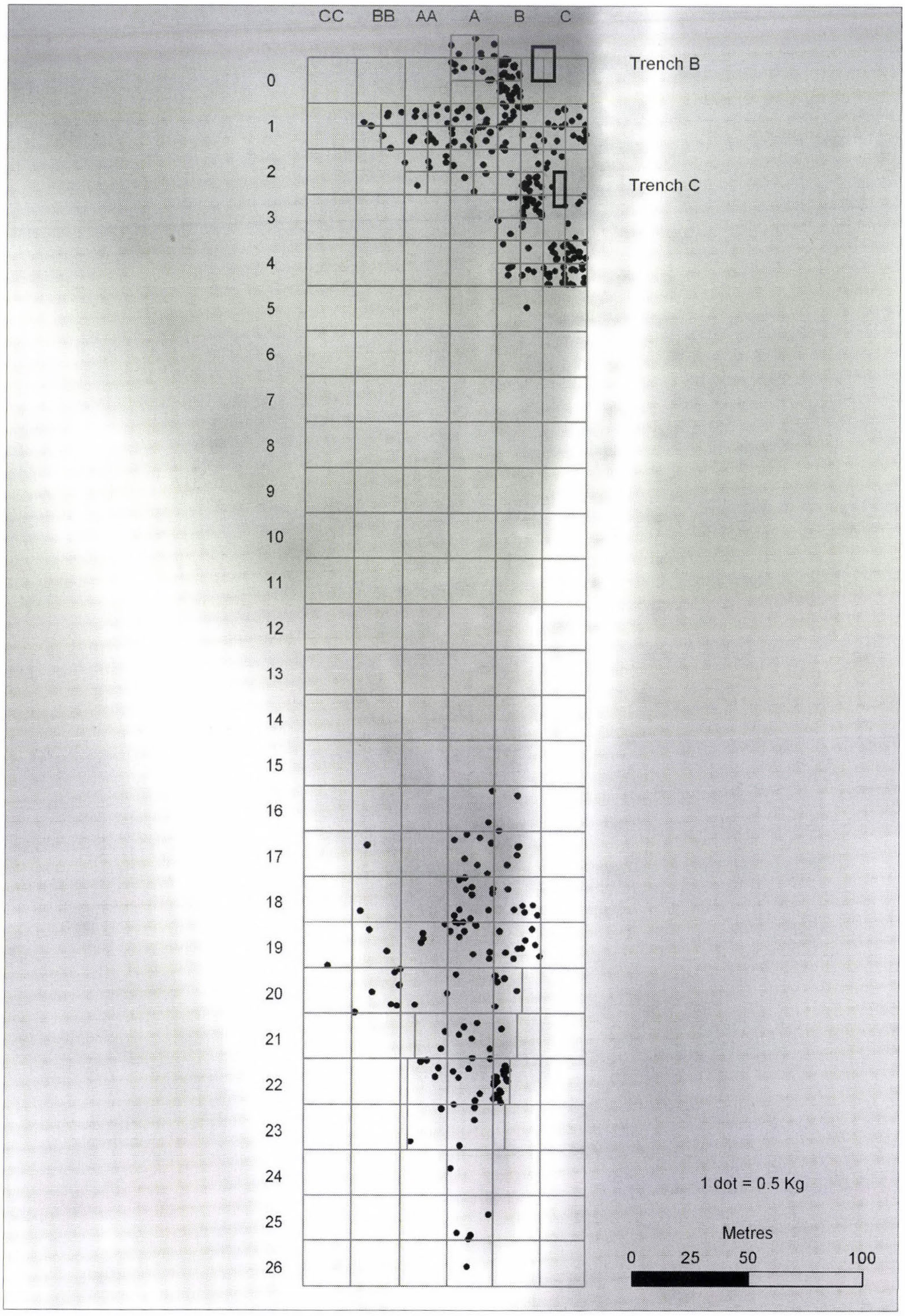


Fig. 9.4. Distribution of daub in the surface survey

certainly suggested by the isolated peak of lithics in square B5, at the very edge of the site. The recording sheets give no information as to whether the lithics were in any way clustered.

By contrast, the daub patterning is more regular. There are definite peaks close to the main sites and then a more gradual fall-off towards the west. This may be because daub is a far less

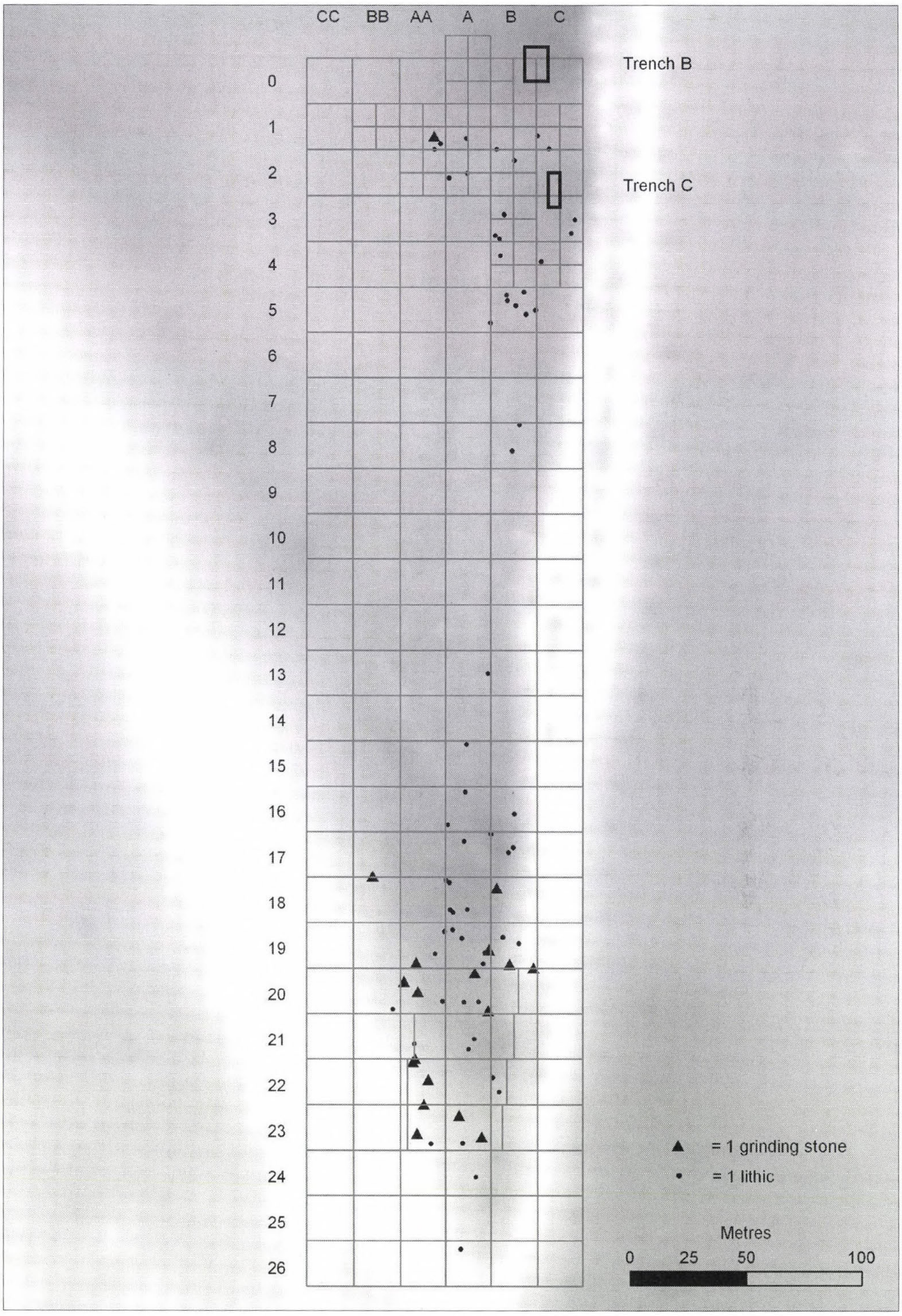


Fig. 9.5. Distribution of stone and lithics in the surface survey

interesting artefact to collect, making it a more reliable indicator of original concentrations. Alternatively, it could show the location of a cluster of buildings, while activities needing pottery were also carried out further away from those structures. Certain irregularities, such as the virtual absence of daub from C3, could be due to such differential use of space.

In general, both sherd and daub finds are located on slightly higher ground *(Figs 9.3–4)*. The highest ground to the north of the site, however, could not be extensively surveyed. Finds density increases in that direction, so site 23 probably corresponds very neatly to the long and narrow shape of the classic Körös culture site (Kosse 1979, 125). It must be pointed out, however, that the western edge of the distribution was not reached during the fieldwalking, and although the densities slowly decrease in this direction, occupation is by no means restricted to the ridge and might stretch for quite a distance away from it. This is all the more striking when compared to the very clear and sudden end of high-density squares at the southern edge of the site in spite of the fact that the ridge of highest ground continues for another 60 m in a southward direction.

The western, lower-lying parts of the site could have been more easily flooded. It would be interesting to find out whether these were areas used for the same kind of dwelling activity as on the highest point of the site or if it was an area for other activities, maybe those too noisy or producing too much unpleasant waste to be carried out on the main settlement. A detailed study of artefact type distribution is essential to answer this question, as coarse categories like 'pottery' or 'lithics' are entirely insufficient. But it is also possible that some of the actual structures in which the Körös occupants on the site lived were located in this still reasonably safe area, while the higher ground to the east on which Trench 23B is located was essentially created by the human activity of middening.

Comparing the geophysical anomalies to the squares of higher finds density reveals an equally complex picture. Higher sherd density coincides with the occurrence of pits in those parts of square B0 which have been walked and also in the adjacent B1 NW. But the very large pit in square A0 does not show up at all in the distribution, even though its northern half lies in a square we investigated. This could be due either to the history of this pit, which need not necessarily be plough-damaged in those layers containing pottery and daub, or to the field camp erected over its southern half which may have caused some disturbance. As daub densities are also very low in these squares, the low sherd density is likely to be genuine rather than man-made. This means that unchecked surface collection may not have skewed the original finds distribution to a significant degree. Absolute certainty can, of course, only come from the excavation of this large feature, which could reveal a largely intact spread of daub or pottery.

Around Trench 23C, sherd densities are generally higher in those squares that are close to pits revealed by geophysical survey. Daub density is a more accurate indicator, as it is highest in squares B3 NE and C4, where the geophysics show pit clusters.

Finds density between the two rises is very low, sometimes as little as one sherd per square, and fall-off is rapid. It is unlikely that this represents the deliberate spreading of midden material as fertiliser.

The southern concentration

The diagnostic material from the southern distribution has been classified as AVK, with the exception of one Copper Age sherd from B18. At this site there are also some very large lumps of daub, occasionally with reed impressions (especially from squares A18 and A19; finds numbers 2034 and 2041), which point to the existence of a large structure. There are no netsinkers at all on this site, but lithic material, especially grinding stones, is more abundant. This difference might be seen in the context of cultural and economic transformations from the Körös culture to the AVK.

The finds distribution here is far more regular than in the northern sector, as the site had not been significantly disturbed by either people or animals. There is a gradual rise in finds density, until a peak is reached in A18. From then on, finds become rarer again towards the south, but the end of the distribution could not be established in that direction. To the west, it is likely that the distribution did not continue much beyond row CC. The overall finds density is far lower than for the northern rise (the average weight per square in the north was 2.28 and 4.43 for daub and sherds respectively; in the south, the corresponding values are 1.86 and 2.48), which supports the suggested trend of AVK sites being generally shallower than Körös culture ones (Kosse 1979, 137). Alternatively, a different pattern of discard may have been prevalent in the AVK. Large dumping events like the ones forming finds-rich deposits on site 23 could be absent, and most of the material instead buried in pits.

South of A18, there is a second peak in density in row 22. Especially square B22 stands out, as finds were extraordinarily numerous here. This square is, however, very close to the present-day canal and has been truncated by modern work there. The concentration could reflect the position of a genuine second cluster of finds, perhaps an AVK pit, or could be due to re-deposition of such finds during digging or cleaning out the canal. Either way, it is clear that this site has at least partially been damaged.

Lithic distribution in general follows those of sherds and daub in being most dense in row 22 and in square A18, although it is slightly higher in the latter. In contrast, grinding stones were found in an area where daub and sherds were already beginning to be less frequent, namely in rows 20 and 23. They are thus consistently further south than the main densities of the other artefacts. This is the clearest evidence for a possible spatial separation of activities revealed by this survey. If grinding stones are found in the loam pits of houses, as was for instance the case at Bylany in the Czech Republic (Pavlů 2000, 282), then we could perhaps pin down the location of AVK buildings, with a main discard area located slightly further to the north. However, as these grinding stones are much smaller fragments than those recovered from Bylany and could have moved further after discard, this idea must remain mere speculation. Alternatively, cereal processing could be an activity carried out away from putative houses, as may be the case with in Trench 23A of Ecsegfalva 23. It is also interesting to note that no grinding stone has been found on the very low-lying area CC20, thus pointing to a potential absence of habitation structures there. To be clear on this point, some additional geophysical survey could be undertaken, as it has revealed later LBK loam pits very clearly at Diemarden and Butzbach in Germany (Saile and Posselt 2002; Schade 2003).

As was true for the Körös culture site 23, most of the AVK material is concentrated on higher ground, but again not the whole of the rise is used. Also, some material is again found on lower-lying ground, suggesting that while putative buildings may have been located on the rise, activity was certainly not limited to it. Closer analysis of the sherds in particular could help to further define potential activity areas in the future. The preserved part of the site being nearly undisturbed by ploughing certainly makes it appear to be one of the few AVK settlements where such an approach could stand a chance of success.

Additional surveys

In order to test whether higher ground was consistently chosen for settlement and whether the rises generally represent chronologically distinct phases of occupation, two other slightly higher areas in the vicinity of site 23 were investigated. No systematic collection was, however, undertaken.

On a rise c. 800 m south of site 23, some Copper Age material was discovered in a very sparse scatter (finds no. 8269). The investigation of the inner edge of the Kiri-tó directly opposite the Körös culture occupation of Ecsegfalva 23 yielded few and mostly undiagnostic finds (mean sherd density: 0.17 g per square metre; mean daub density: 0.21 g per square metre). This might be due to more intensive modern agricultural and drainage activities. The recovered daub, pottery and lithics do at least show that the area was not empty. However, a lot of ground was taken up by dense reeds, and field walking opposite the AVK site was not possible.

Conclusion

The landscape around site 23 was in use in more than one phase of the Neolithic and Copper Age. Slight rises in the local topography were consistently chosen for settlement. This preference is understandable considering the risk of flooding in the area, but other reasons may also have played a part. In terms of the Great Hungarian Plain, the sites were located in a prominent position and were visible from afar (see Gillings, chapter 3). They were fixed reference points for people moving through and working in the landscape, in routines themselves perhaps played out spatially through distinct activity areas. Living at the sites would have created a sense of community and belonging. They were one of the principal foci of social interaction and hence identity creation for the people dwelling on them. As such, they were charged with emotions and also with memories. The neat pattern of exclusive Körös culture and AVK distributions may suggest that sites used by previous inhabitants were known and deliberately avoided by later generations. Yet, as the persistent trickle of artefacts leading away from the sites reminds us, they were not isolated, exclusive foci for dwelling, but part of a larger inhabited landscape.

Geophysical surveys at Ecsegfalva, 1998 and 1999

Michael A. Hamilton

Ecsegfalva surveys

In 1998 some nine geophysical surveys were conducted on Neolithic sites in County Békés, as part of the site selection already described in chapter 1. Details of the four surveys not reported here are available from the author; the final five sites were those at Ecsegfalva, ending with the northern half of Ecsegfalva 23 (*Figs 9.1* and *9.6*).

The survey methodology was identical on all the Ecsegfalva sites. First, a series of 20 × 20 m grids were surveyed with a Topcon GT-303 total station. This was also used to produce a simple contour plot. These grids were then surveyed with a Geoscan FM36 fluxgate gradiometer. Readings were taken with 1 m transverse interval and 0.5 m sampling interval, making 800 readings per grid.

Table 9.1. Summary of Ecsegfalva geophysical surveys

Sites	Year	20 × 20 m grids	Area surveyed	Illustrated
Ecsegfalva 18 W	1998	34	13600 m^2	*Fig. 9.11*
Ecsegfalva 18 SE	1998	2	800 m^2	*Fig. 9.12*
Ecsegfalva 18 E	1998	10	4000 m^2	–
Ecsegfalva 16	1998	11	4400 m^2	–
Ecsegfalva 23	1998 and 1999	9 + 20	11600 m^2	*Figs 9.7–10*
Ecsegfalva 21	1999	3	1200 m^2	–
Ecsegfalva 20	1999	3	1200 m^2	*Fig. 9.13*
TOTAL		92	3.68 ha	

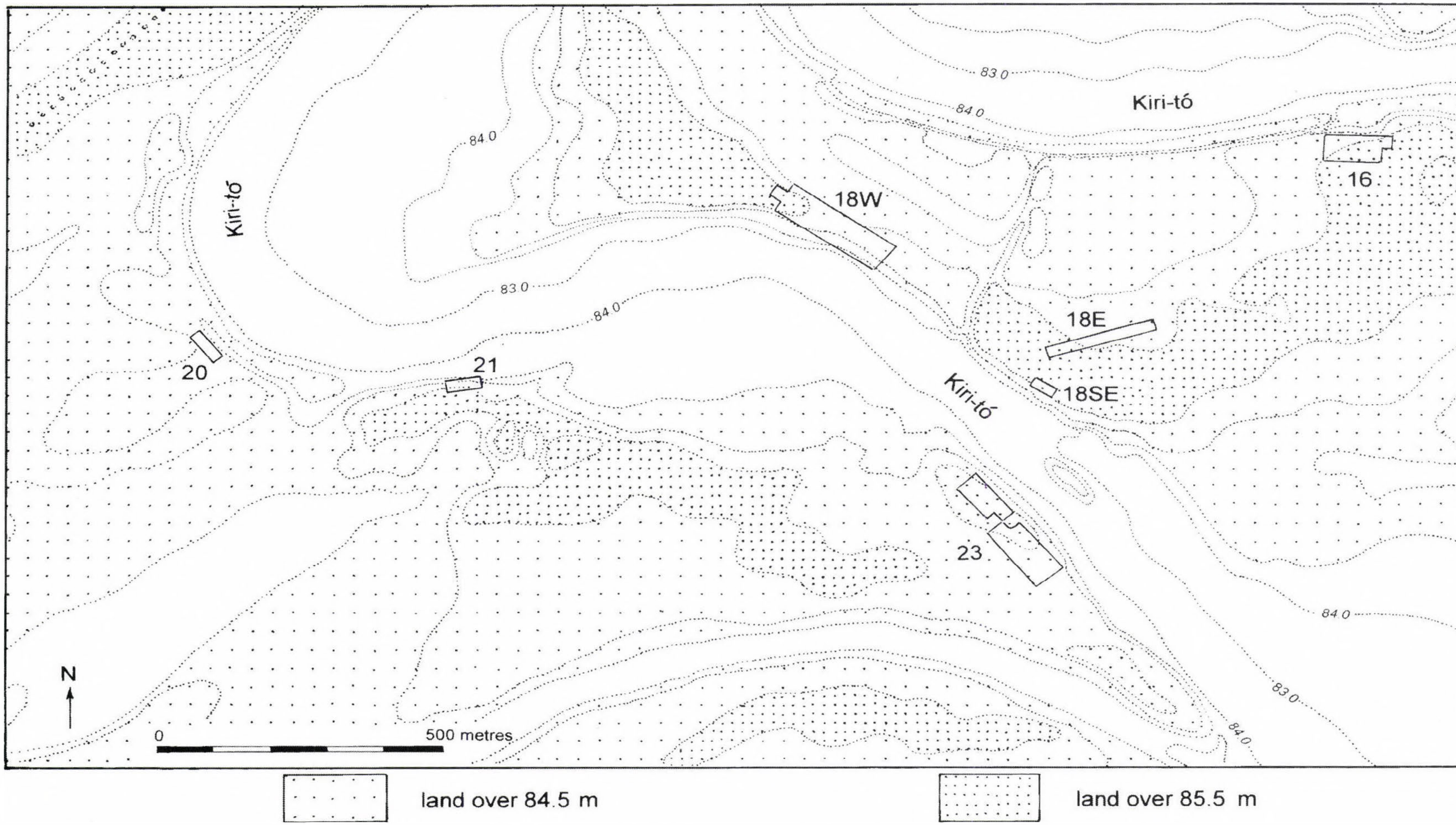


Fig. 9.6. Areas of geophysical survey around the Kiri-tó

In 1999, the project having settled on the Ecsegfalva area for its excavations, it was necessary to complete the survey of site 23, the area to the south of the drainage ditch or channel on the edge of the Kiri-tó. The methodology was exactly the same, and some twenty additional grids were surveyed. Additional sites at Ecsegfalva 21 and 20 (Ecsedy *et al.* 1982) were also surveyed *(Table 9.1)*.

The areas surveyed at Ecsegfalva varied in terms of ground cover. The southern half of Ecsegfalva 23 and also Ecsegfalva 18W were under lucerne, a shrubby animal fodder crop that tended to catch the surveyor or the gradiometer, hence the occasional flaw in the survey. The very south-eastern end of Ecsegfalva 18W was a maize field. All the other sites were essentially short-cropped grassland that was ideal. In both years the conditions were very dry. The machine used, the rather elderly Geoscan FM36 from Cardiff University, was very stable and required comparatively few adjustments, though a few small problems did result in some grids being re-surveyed.

Survey critique

Because a good geophysical survey publishes much of the raw information in the form of the plots it is uniquely possible to critique such surveys, whereas the final published forms of most excavations rather obscures methodological flaws. The speed at which most geophysical surveys are conducted also limits the time for introspection, as obviously the aim is to survey as much area as possible. Looking back on old surveys always throws up obvious flaws, things that need re-doing or the need for extensions to the original survey. These surveys are no exception. First, there are a couple of slightly 'spotty' areas of the 1999 Ecsegfalva 23 survey that clearly look like machine/operator errors. This is most obvious immediately to the west of area C. However, whilst annoying on professional grounds, this does not really impact on the results. More serious is that clearly the 1999 Ecsegfalva 23 survey should have been continued further to the east, just to doubly confirm the apparent edge of area B, though there was a track in this area that might have obscured things.

To an extent this geophysical survey is doing double duty. On the one hand it was used in the decision-making process about where to locate excavations, while on the other, given the results of those excavation, the geophysics can now be used to extrapolate for the non-excavated parts of the site.

Results

Ecsegfalva 23 (Figs 9.7–10)

Aside from where the survey ran over the edge of the old banks defining a more modern water-course, the only clear sign of modern features were two linear anomalies. Curving linear feature (L1) seems to originate in the shepherd's house, and is probably due to wheeled vehicles. L2 roughly matches the edge of the cultivated area and could also be due to wheeled vehicles. Closer inspection of the plots also reveals quite subtle linear features, especially south of the twin banks; these are probably the result of modern agriculture. There was no obvious trace of modern iron.

There are three clear areas where archaeology seems to occur, which have been defined as areas A, B and C. Immediately south of C are a few additional anomalies, and there is another such area between B and C.

Area A appears as six or seven dark blobs. It was originally suspected that these might be concentrations of daub, but excavation of one of these produced relatively little cultural material

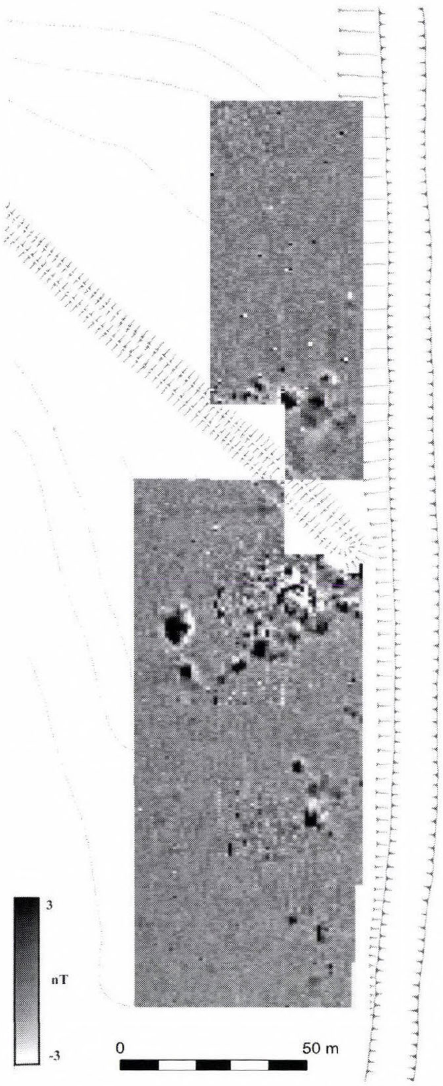


Fig. 9.7. Basic plot of the surveyed area of Ecsegfalva 23

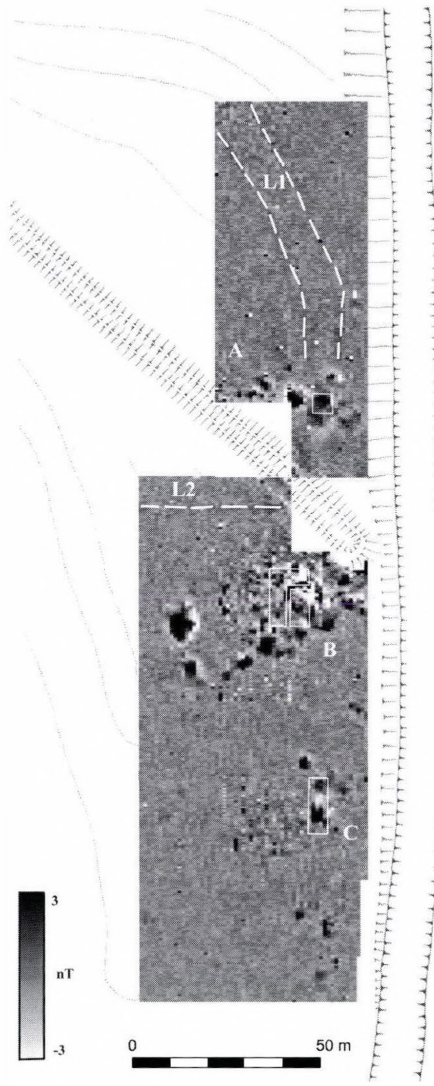


Fig. 9.8. Main areas of archaeology and modern archaeology in Ecsegfalva 23

and instead the anomaly appears to be a pit or cluster of shallow scoops, later reused for an AVK burial. Therefore it is likely that Area A is a cluster of pits.

On this basis it seems likely that the three blobs at C and possibly the blob between C and B, and the two anomalies south of C, can also be interpreted as pits or scoops.

Area B was the main area of interest and will be examined in greater detail. This area has three main elements. There is an L-shaped line of blobs (i). Possibly a continuation of this is a second line (ii). This defines a possible rectangular area (iii) on two sides. The area, partly covered by the drainage banks and probably cut by the channel, measures at least 30 m by 20 m and is orientated NE-SW. This represents a magnetically interesting area, with lots of variation, in marked contrast to the areas away from the archaeology.

The lines of anomalies at i and ii are probably pits or scoops, given their resemblance to area A. The excavations within B also picked up depressions on their southern edge, again consistent with an interpretation of these as pits.

The excavation suggests that the rectangular area (iii) is the product of cultural material, principally daub and pottery. Within this area other shapes suggest themselves. One interesting

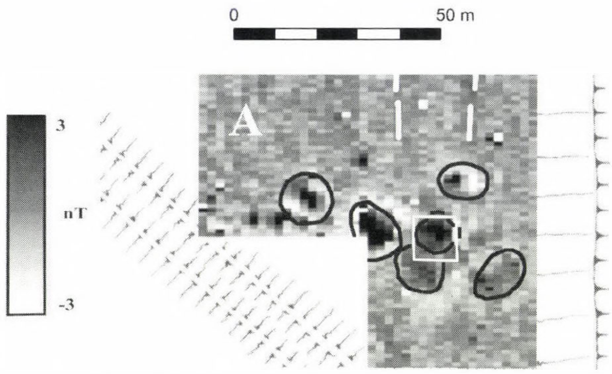


Fig. 9.9. Interpretation of Ecsegfalva 23A

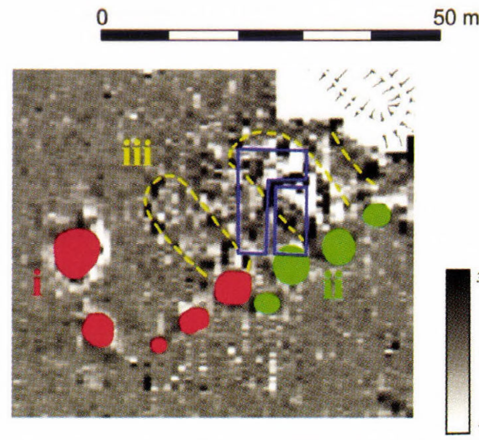


Fig. 9.10. Interpretation of Ecsegfalva 23B

observation is that the rectangular area may be sub-divided by two slightly less active areas, creating at least two, possibly three small sub-rectangular features. These would each measure 20 by 7 m and would be oriented SW–NE. It would be nice to interpret these as structures, as their edges do seem to be marked by some stronger anomalies, but there was no confirmation of this from the excavation. However, the excavation did appear to confirm, in terms of finds distributions, the less active areas between these sub-rectangular features. There are additional shapes, including a flat wedge-shaped anomaly covered by the excavation trench (Trench B), but this did not match anything found and may be simply concentrations of daub.

Ecsegfalva 18

The Ecsegfalva 18 area was so large (Ecsedy *et al.* 1982) that three discrete surveys were conducted, numbered 18W, 18E, and 18SE.

Ecsegfalva 18W (Fig. 9.11)
Ecsegfalva 18W ran along a low Pleistocene bluff. There were a number of faint SW–NE linear anomalies which appear to be land-division features. The main interest in the survey are three concentrations of anomalies. The eastern and central anomalies appear similar: small clusters of high and low readings, similar but less strong that Ecsegfalva 23 area A. A small excavation on the eastern anomaly produced AVK material in what might be a shallow scoop or other feature (see below). However, while this trench was in the centre of the concentration it may have missed the main anomalies (see *Fig. 9.11*). The western anomaly is more confused, with some individual anomalies but other anomalies perhaps more linear. It is not obvious as modern and therefore this could also be prehistoric.

Ecsegfalva 18SE (Fig. 9.12)
This was a very small survey (two gradiometer grids) in an area defined by Roman earthworks to the north and east, and by a slope down to a stream to the south. This feature was crossed to the south by a linear anomaly, presumably a modern field boundary. However, north of that was a strong rectangular anomaly very similar to features located by the author in Bulgaria and identified by excavation as domestic structures of fired clay (Bailey *et al.* 1998). There were additional features on the south–eastern edge. This area also produced much Late Neolithic pottery and fired building material, which would be consistent with this interpretation.

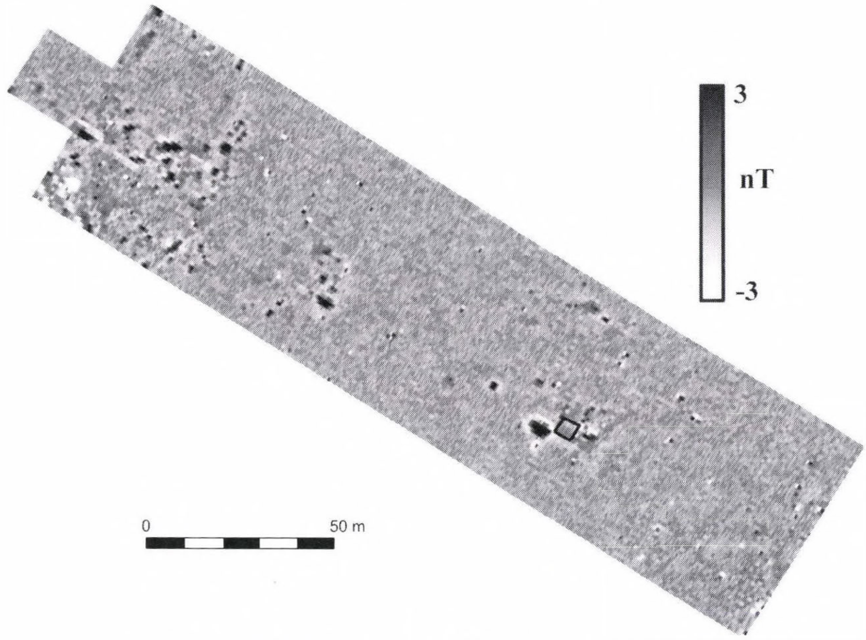


Fig. 9.11. Ecsegfalva 18W. The square marks the trial excavation

Ecsegfalva 18E

This 200 m transect was across an area identified (Ecsedy *et al.* 1982) as a continuation of the main artefact scatter. No plausible archaeological anomalies were identified.

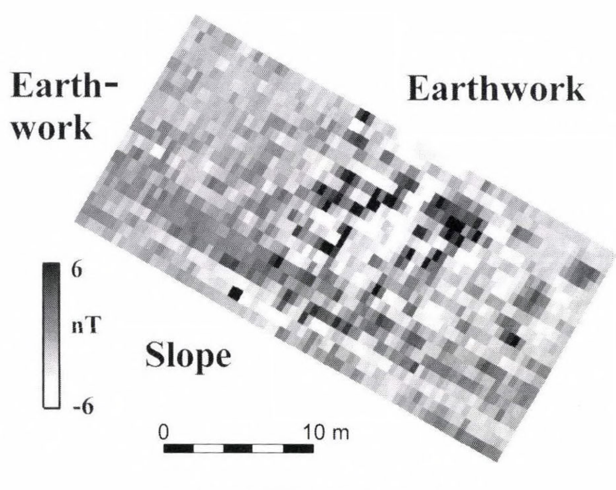


Fig. 9.12. Ecsegfalva 18SE

Ecsegfalva 16

The south-east edge of this site was bounded by a Roman earthwork. To the north was a track and quarry. In the quarried face of the northern inner edge of the Kiri-tó were pits which produced Neolithic Körös culture pottery and a polished stone axe. The surveyed area produced a very confused geophysical plot, with a number of clear modern anomalies identified. There were a number of slight anomalies across the survey, especially three opposite the quarried face, which were possible as additional pits.

Ecsegfalva 21

This was on a slight ridge close to the Kiri-tó drainage channel. Unfortunately while there were prehistoric ceramics present on the surface, the site looked disturbed, with distinct linear and circular depressions, as well as clear signs of iron on the gradiometer survey. The suspicion was that some anomalies might be military in nature. It is possible some of the anomalies are prehistoric but the disturbance made interpretation impossible.

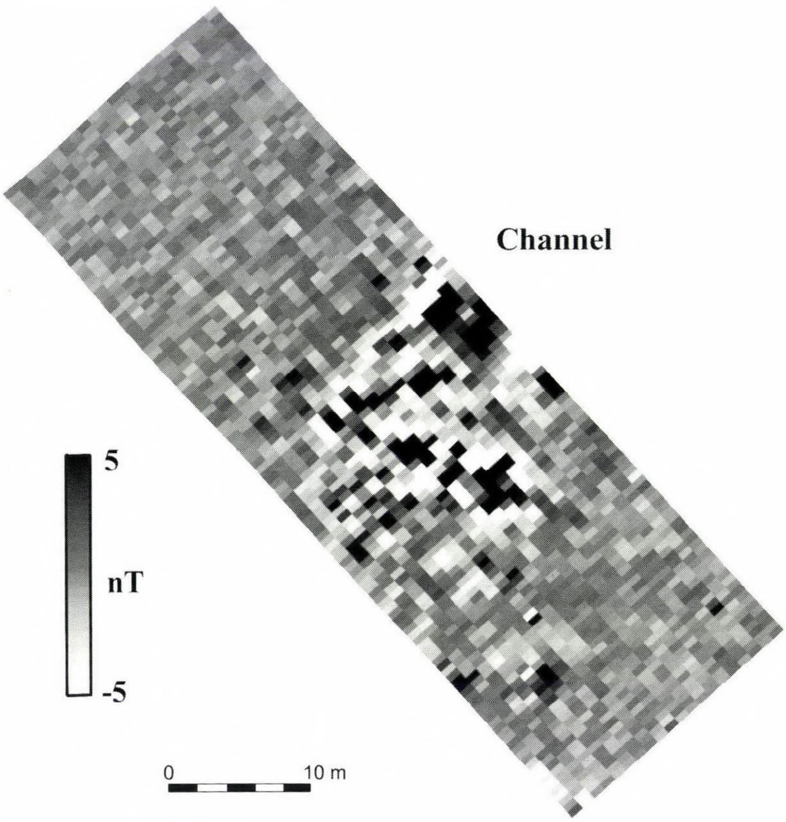


Fig. 9.13. Ecsegfalva 20

Ecsegfalva 20 (Fig. 9.13)

In a similar topographical position to site 21. A much more concentrated group of anomalies forming a distinct 20 × 20 m area. The north-east edge of the anomaly was cut by the meander. The overall impression is either an oval or rectangular area. There are a few anomalies that might be pits, and the area appears to be sub-divided by a strong anomaly on a NW to SE orientation. In many respects this area resembles the rectangular area of Area B at Ecsegfalva 23.

Conclusion

The geophysical surveys from Ecsegfalva form a good group, illustrating sites for future investigation. In general the technique works well in this area. Geophysical survey was also crucial for the interpretation of Ecsegfalva 23B, though in retrospect it would of course have been useful to investigate by excavation a wider range of anomalies in this area.

Excavations at Ecsegfalva 23

Alasdair Whittle and *István Zalai-Gaál*

The surveys described above indicated that probable features and finds were not distributed continuously across the total extent of the 'site'. The greatest concentration of magnetic anomalies appeared to coincide, or at least overlap with, the highest point of the ridge or levée fronting the Kiri-tó meander. This represents an area approximately 40 by 40 m, on a slight rise some 30 cm above its surroundings (*Figs 9.1, 9.8* and *9.14–17*). As already noted, such measurements can give only an approximate indication of original differences in elevation, but such differences were presumably significant, and it seems little coincidence that the greatest concentration of features and the most substantial deposit were found in excavation on the highest part of the site.

Trenches were sited to examine these differences. Trench B was placed to explore the apparent major concentration of activity within the site; Trench A was located to investigate the apparent northern limit of the site; and Trench C was opened to give an idea of one of the smaller clusters of magnetic anomalies indicated by geophysical survey.

Most of the excavated deposits were dry-sieved through 4 mm screens, and the samples taken for recovery of carbonised plant remains were wet-sieved. Details are given below in chapter 23 by Amy Bogaard, Joanna Bending and Glynis Jones.

A full listing of all contexts and summary matrices have been deposited with the Archaeology Data Service and can be found at *http://ads.ahds.ac.uk/catalogue/resources.html?whittle_ahrb_2005*. A simplified version is also given by Krisztián Oross in chapter 27 here.

Trench 23B

Trench 23B was laid out in 1999 to explore what appeared from geophysical survey to be a major concentration of features coinciding with the highest part of the site. Its precise location was arbitrary, but it was placed to avoid possible disturbance from the Kiri-tó channel, and the water system banks

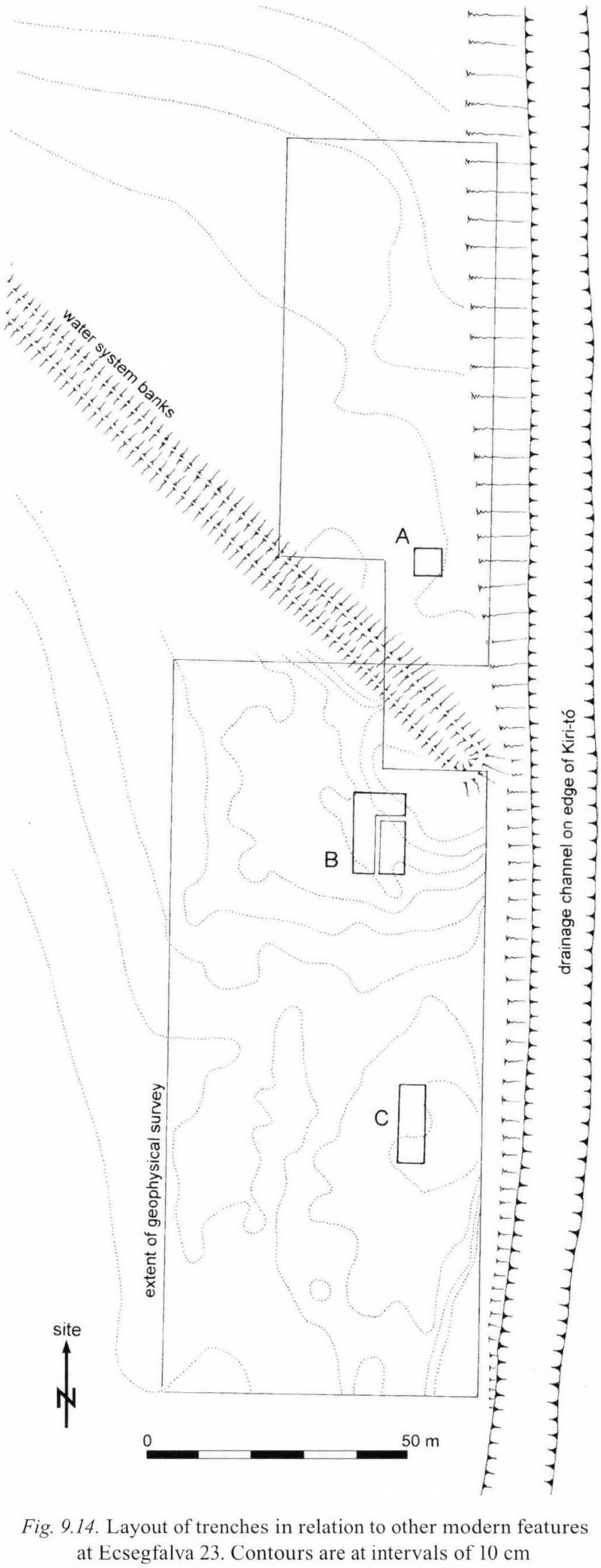


Fig. 9.14. Layout of trenches in relation to other modern features at Ecsegfalva 23. Contours are at intervals of 10 cm

Fig. 9.15. View of Ecsegfalva 23 Trench B (back left) from Trench C (foreground). The Kiri-tó is back right

Fig. 9.16. View of Ecsegfalva 23 Trench B from the south in 2000

Fig. 9.17. View of Ecsegfalva 23 Trench B from the north in 2001. Trench C is in the background and the Kiri-tó is to the back left

noted above (*Figs 9.1, 9.7–8,* and *9.14*). At the outset of the excavations, it was anticipated that the stratigraphic situation might be something like that described for Endrőd 119 (Makkay 1992), with minimal preservation of the occupation deposits themselves, and with much of the surviving archaeology represented by subsoil features and their finds. The trench was initially laid out as an area 10 by 5 m *(Fig. 9.18)*, to give close control over anticipated stratigraphy and features (we are extremely grateful to Ferenc Horváth for discussion of methods). In the event, it was apparent from the first machine removal of topsoil (all topsoil was so removed, and no attempt was made to sieve this) that an extremely rich deposit or layer of Körös culture date had survived above the subsoil *(Fig. 9.19)*, and the time required to both excavate and record this deposit necessarily kept the area of excavation a small one. Indeed, after cleaning and excavating the uppermost deposit across the 10 by 5 m trench, it was quickly realised that the deposit was likely to be of some depth, and to maintain close stratigraphic control the trench was subdivided into five areas or boxes: North, Centre-West, Centre-East, South-West and South-East (hereafter N, CW, CE, SW and SE) (*Fig. 9.20;* and see *Fig. 9.25*). The N box was left at this point in the 1999 season and excavation was concentrated within the remaining boxes. The excavation continued (having been backfilled for protection between seasons) within these confines in 2000, including the resumption of excavation of the N box. These five boxes were more or less fully excavated by the end of the 2001 season.

Trench 23B was further extended in 2001 on its north and west sides, to give a total area of 15 by 10 m *(Fig. 9.18)*. The new area of 2001 was subdivided into the North Extension and

West Extension (hereafter N Ext and W Ext). The rich deposit continued across most, but significantly not all, of this new area, and in the time available it was possible only to excavate the upper part of the deposit *(Figs 9.21–24)*. A small sondage on the east side of the North Extension *(Fig. 9.25)* established that the deposit continued downwards for at least another 40 cm (though it is not impossible that this sondage investigated what was part of a pit).

Complete excavation was therefore possible in only a very small part of site 23. Nonetheless it is worth describing the results in some detail. Overall, the area of the site covered by Trench B consisted of an occupation or cultural layer, rich in finds, and normally up to 30 cm thick. This overlay two pits, which were partially excavated in the SE/CE/CW and SW boxes respectively *(Fig. 9.25)*. There was no sign of any pit or definite subsoil feature in the N box, and no definite sign of any major pit or similar feature within the upper occupation layer revealed in the N Ext and W Ext, though such of course could be concealed under the remaining occupation deposit. Only one posthole was found within the area of the occupation deposit, in the N Ext, with a few outside the occupation deposit in the western part of the W Ext *(Fig. 9.25)*.

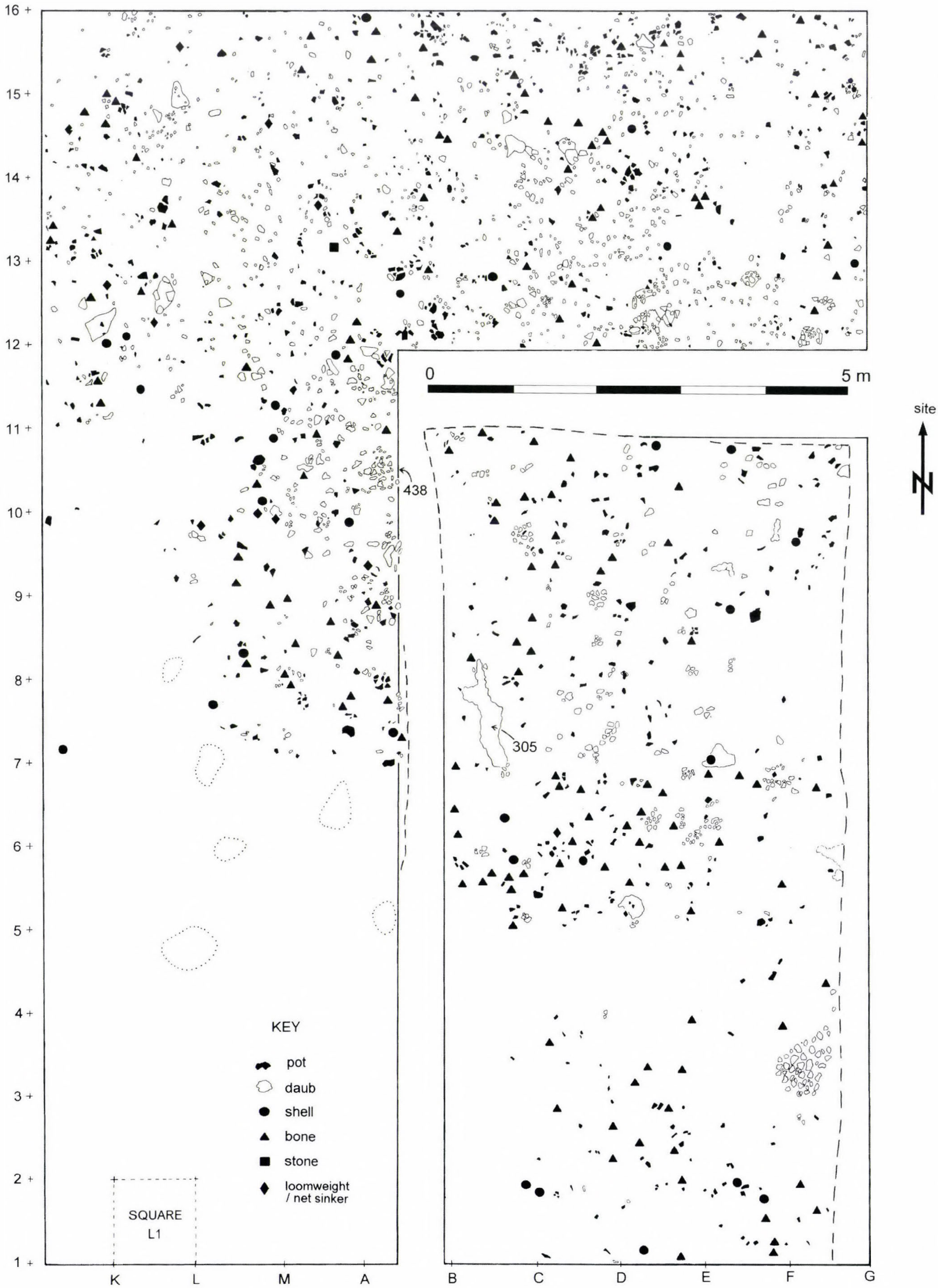
In general the occupation deposit was rich in finds, consisting of abundant sherds, daub fragments, and animal bone, with lesser quantities of fish bone, bird bone, shellfish, two kinds of perforated clay weights, obsidian and limnoquartzite, and worked bone and antler, and small quantities of antler, stone axe fragments, stone beads and stone quern fragments. Very little charcoal was visible to the eye within the deposit, and small quantities only of charcoal and carbonised plant remains were recovered from the occupation deposit by flotation, but it is significant that this recovery was achieved (see Bogaard *et al.*, chapter 23). Phytolith analysis (see Madella, chapter 24) also suggests the presence of cereals and other vegetation, some perhaps brought in by inclusion in animal dung. Micromorphological and chemical analyses (see Macphail, chapter 11, and Crowther, chapter 12) revealed that much of the occupation deposit is formed of ash and other burned waste, with plentiful evidence for burning, trampling, dung and faecal waste.

The pits investigated were not particularly rich in finds, certainly when compared to classic instances elsewhere, from Endrőd 119 relatively nearby (Makkay 1992) to the southern sites around Szeged (e.g. Banner 1934; 1935; Kutzián 1944; Trogmayer 1964; 1968a). They did contain some quantities of daub fragments, as well as sherds and animal bone, and some shellfish, weight fragments, and a little obsidian and limnoquartzite. A little more charcoal was found during excavation of the pits than in the main occupation deposit, and slightly greater quantities of charcoal and carbonised plant remains were recovered by flotation, suggesting perhaps a preservational rather than depositional difference for this category of material between the occupation deposit and the pits. The lower fill of pit 390/395/394 had perhaps accumulated by a combination of natural erosion and small-scale cultural deposition, but its upper fill seems to have been the result of the deliberate deposition of unburnt daub or other weathered material derived from the subsoil. Too little of pit 393 was exposed for much certainty about the fill process.

As detailed below, the few postholes recovered (despite the most careful search) were insubstantial.

In general, the occupation deposit appeared to be remarkably intact. Its top has presumably been touched by the plough, since quantities of material have been found on the modern surface since at least the 1970s. But there is absolutely no sign of deep ploughing, and even in the uppermost parts of the occupation deposit there are fragile finds such as shellfish which remain intact (*Figs 9.19,* and *9.21–23*). Some signs of disturbance by small burrowing animals were found, and the main N-S section along the east side of Trench B reflects this. These disturbances were concentrated in what appear to be limited parts of the fill of pit 390/395/394, but other

Fig. 9.18. Plan of the top of the occupation in Trench B ►



16 +
15 +
14 +
13 +
12 +
11 +
10 +
9 +
8 +
7 +
6 +
5 +
4 +
3 +
2 +
1 +
K
L
M
A
B
C
D
E
F
G
0
5 m
site
N
438
305
KEY
pot
daub
shell
bone
stone
loomweight / net sinker
SQUARE L1

Fig. 9.19. The top of the occupation revealed at the start of the 1999 season

Fig. 9.20. The boxes in the 1999/2000 and 2001 seasons. View from the south in 2001

soil discolourations, for example in the N box, may also be the result of old animal disturbances. In general, this does not seem to have had any major effect on the stratigraphy of the occupation deposit or of the pits, as can be seen in the analysis of the radiocarbon dates, though it cannot be excluded that it has indeed caused local movement of finds. There was no obvious or major layering within the occupation deposit, though as described below its composition was not completely uniform, and there was no clear sign of specific floors or surfaces within the deposit, despite careful search during excavation and of the sections; there is, however, some sign of such features in the columns of deposit sampled for micromorphological analysis (see Macphail, chapter 11). The roots of the lucerne crop were found in the 1999 season to have penetrated the upper few cm of the occupation deposit, and the possibility of worm-sorting of the deposit is discussed below (chapter 11).

The condition of finds varied but was in general good. A significant number of shellfish were recovered

Fig. 9.21. The North and West Extensions from the south, 2001

Fig. 9.22. The North and West Extensions from the north-west, 2001

Fig. 9.23. The North and West Extensions from the east, 2001

more or less intact *(Fig. 9.26)*. Animal and other bone was slightly weathered. Sherds ranged in size from small fragments to large portions of whole profiles; both edge-breaks and surfaces appear quite fresh. Details of these and other finds are given in the relevant chapters below. The impression is of a body of material which may have been subject to some weathering by exposure, but to a limited extent, and deposits of intact shells suggest also a lack of trampling by people and animals in the part of the site where they occur.

Despite the small area uncovered, therefore, the occupation deposits and pits together raise a considerable number of significant issues, which underlie the basic descriptions in this chapter and the specialist analyses which follow. Clearly this was a locus where living took place, with a wide range of activities represented, over a period of time sufficiently long for a not inconsiderable deposit to have accumulated. Deposition of material may have followed a number of different trajectories, from casual discard to very controlled placement. The occupation deposit is clearly bounded on its western side. Some areas may have been free of trampling or subject to rapid accumulation. The quantities of burnt daub fragments show the former existence of structures of some kind, not necessarily all of the same character, and the presence of daub fragments and other subsoil-derived material in the fill of the pits connects the latest episode or episodes of occupation seen in the top of the occupation deposit with a potential cycle of pit digging, construction of structures, and burning of structures.

As well as the larger subdivisions already noted, a grid of metre squares was used to record the excavation of Trench 23B. In some cases, especially in the upper deposit (and reflected in *Figs 9.18* and *9.24*), all the finds were recorded on plan, but in all cases finds were recorded by metre square. The bulk of the excavated deposit was dry-sieved through 4 mm screens. Selected samples of uniform size were subject to water flotation, principally for the recovery of carbonised plant material, though this process did also produce small animal bones and fragments, fish bone, shellfish fragments, tiny obsidian and limnoquartzite flakes, and a stone bead (14537, 464, square C16). The deposit and the pit fills were excavated principally by thin spits, of varying

Fig. 9.24. The upper occupation deposits in Trench B. The trench grid is given on *Fig. 9.18* ▶
Fig. 9.25. Subsoil features and final extent of excavation in Trench B. The trench grid is given on *Fig. 9.18* ▶

458
440
452
451
453
455
454
456
459
0
5 m
site
N
FINDS NOT RECORDED INDIVIDUALLY
FINDS NOT RECORDED INDIVIDUALLY
KEY
pot
daub
shell
bone
stone
loomweight / net sinker

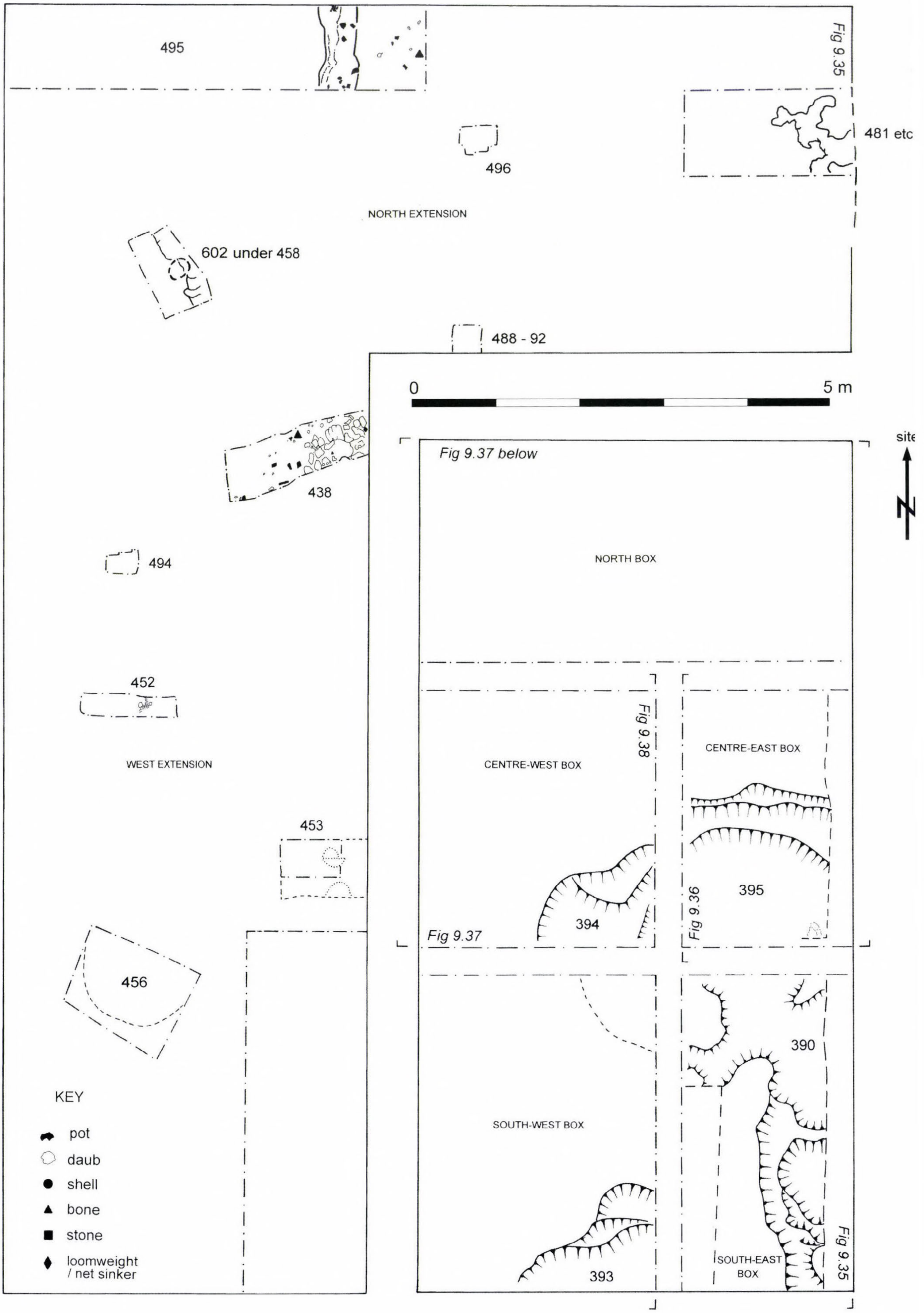

495
Fig 9.35
481 etc
496
NORTH EXTENSION
602 under 458
488 - 92
0
5 m
site
Fig 9.37 below
438
NORTH BOX
494
452
Fig 9.38
CENTRE-WEST BOX
CENTRE-EAST BOX
WEST EXTENSION
453
395
394
Fig 9.36
Fig 9.37
456
390
KEY
pot
daub
shell
bone
stone
loomweight
/ net sinker
SOUTH-WEST BOX
393
SOUTH-EAST
BOX
Fig 9.35

Fig. 9.26. Context 440 in the West Extension

thickness, but normally around 5 cm in the occupation deposit, while sometimes thicker in the pit fills. The principal stratigraphic units are described below and indicated on the sections. Since there are many contexts, and since the occupation deposit and the pit fills were to a considerable extent homogeneous, not every context recorded is individually described in the main text; a full list has been deposited with the finds.

The uppermost deposits

Trench 23B was located within the largest concentration of geophysical anomalies and close to the highest point on the ridge adjacent to the Kiri-tó. While the area initially opened in 1999–2000 showed a continuous spread of occupation material, the N Ext and W Ext opened in 2001 showed that the deposit was locally finite. In the NW corner of the N Ext, and especially in the W part of the W Ext, there were clear gaps or blank areas in the distribution of material, producing, especially in the case of the W Ext, a quite abrupt transition from occupation deposit to largely artefact-free dark soil (*Figs 9.18* and *9.24–25*). This gave a sense of a very roughly quadrangular block or area of occupation deposit aligned roughly NW–SE, diagonally across the trench. From the outset, it was apparent that the quantity of material diminished towards the southern (and slightly lower) end of the deposit, and this clear impression from the SW and SE boxes was dramatically reinforced by the total absence of finds from the southern part of the W Ext; from the outset also it was noted that finds in this area were smaller and more fragmented. Finds were abundant in the CW and CE boxes, but were most numerous in the N box, the N Ext and the relevant adjacent part of the W Ext.

The deposit at this level consisted largely of a dark to grey brown soil, heavily flecked with small fragments of burnt daub and some highly comminuted shell fragments. Micromorphologi-

Fig. 9.27. General view of context 458 in the North Extension, from the west. For detail, see *Fig. 13.33*

cal samples were taken in square C15 and in C12 on the southern baulk (nos 14647, 14631) and are reported in chapter 11 below. In the eastern part of what came to be defined as the N and CE boxes, in squares G8–9 and F8–9, a fine white silty material was found, almost ashy in texture. This upper deposit with the finds within it was planned in detail at three levels: at its very top immediately below the topsoil, and then about 5 cm and 10 cm deeper respectively (because of the area ultimately opened and the slight slope, it cannot be claimed that the spits in question are completely uniform across their extent); the top and the lower level are shown here in *Figs 9.18* and *9.24* respectively. The uppermost level (430, 431, 301) shows relatively little differentiation. The deposit is dominated by burnt daub fragments, with sherds and animal bone also prominent. The most obvious concentrations of daub were in the eastern part of the N Ext. By the level defined only a very little way into the occupation deposit (445, 457, 344, 308, 340, 307) rather greater differentiation could be seen *(Fig. 9.24)*.

In the western part of the N Ext there was a marked concentration of daub fragments (458), redder than was often the case, and with linear reed impressions clearly visible along their lengths. Unlike the usual situation in which daub fragments were part either of a general spread of material or small loose concentrations, 458 gave the clear impression of originally linked pieces spreading out in two or three directions (*Figs 9.24* and *9.27*). Mixed in with these pieces were a series of small fragments of daub or plaster, whiteish to yellow on one smooth surface and redder on the other, slightly less smooth surface; these were about 3 cm thick. These were recovered largely as separate small fragments, but subsequent conservation showed it possible to conjoin at least some of these fragments into continuous surfaces. Detailed analysis of these and 458, as well as of the daub assemblage in general, is given below by John Crowther in chapter 12 and by Ângela Carneiro and Inna Mateiciucová in chapter 13. The discussion there notes the obvious possibility that 458 represents some kind of burnt and collapsed wall, possibly even a corner of a structure. The small fine fragments can be interpreted in differing ways: as fine wall surface; as floor surface; or as part of some kind of oven or hearth fixture, possibly closed and possibly set outside the structure (or structures) which it may have accompanied.

In the removal of the western corner of 458, from the level of 464, and in order to take a sample of deposit for micromorphological analysis immediately below 458, a small posthole was found, 602 (*Figs 9.25* and *9.28*). This was some 17–18 cm in diameter at its top tapering to 12–13 cm at its base, reaching some 30 cm below the level of 458, with a fill of dark soil flecked with small fragments of daub, but clearly distinguishable from a surrounding matrix of what was presumed to be further occupation deposit. Without further excavation, it could not be established whether 602 belongs with 458, or to a slightly earlier stage in the formation of the occupation deposit, but the coincidence is certainly suggestive of a direct link.

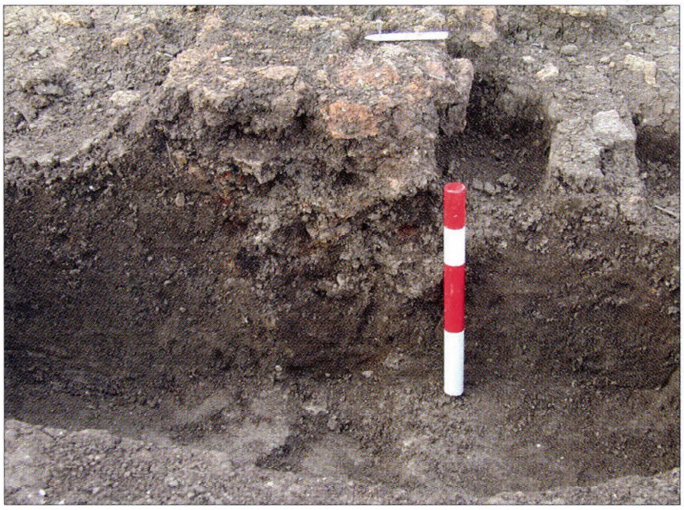


Fig. 9.28. Posthole 602 under 458, North Extension

Two other daub concentrations may be linked to 458 (*Figs 9.18, 9.24,* and *9.29–30*). 305 in the N box was a short length of concentrated daub fragments, just visible in the uppermost level and then more prominent with successive spits. It consisted of closely set, substantial pieces of daub, forming a linear setting about 15–20 cm across and some 10 cm deep. On the same alignment, slightly diagonal across the trench and heading directly for the 458 concentration, was another linear concentration of daub fragments, 438. This was also visible within the topmost deposit but became better defined lower down. This also consisted of substantial daub fragments, though not quite as closely set as in 305. A small sondage over 438 (*Figs 9.25* and *9.30*) suggests that this is

Fig. 9.29. Walling context 305 (left foreground) at an early stage of excavation in 1999 of context 313 in the Centre-West box

Fig. 9.30. Walling context 438 in the West Extension

a little deeper than 305. It is presumed that 305 and 438 are continuous, though the intervening baulk was not removed in excavation. Nor did 438 join directly with 458.

In the eastern part of the N Ext, dense concentrations of daub remained visible, but without linear structure. In the eastern part of the CE box there was a small setting, 311, of flattish grey daub pieces, next to the area of white fine material in squares F8–9 and G8–9, noted above.

It might be possible to think therefore in terms of some kind of structure in the area of the N Ext, part of the W Ext, the N box and parts of the CE and CW boxes. Given the small clues noted above, this might be thought of as quadrangular, and if such a putative structure were rectangular, it might have been aligned SW–NE, roughly at right angles to the Kiri-tó, or conceivably as a shorter affair NW–SE, very roughly parallel to the Kiri-tó. As discussed below in chapter 13, it is difficult from the slight evidence to hand to be sure of what might go with what. Daub concentrations at the eastern end of the N Ext may belong with other possible structures, for example, and collapsed daub from the lightly-framed walls of burnt structures may anyway give very imprecise indications of original form and groundplan.

Nonetheless, within the general spread of material of varying categories already described, a further striking concentration of finds was observed, which coincides with the suggested area of a former structure, especially within the N Ext (*Figs 9.18* and *9.24*). Here and in the N box, as well as daub fragments, sherds and animal bone, there was a marked concentration of: large perforated spherical and cylindrical clay weights (and fragments of these); an unusual and particularly fine cylindrical, laterally perforated clay weight, in square A14; small pear-shaped and drum-shaped clay weights with a top perforation (chapter 28); worked bone and antler including points and toggles (chapter 29); some obsidian and limnoquartzite (chapter 31); the two joining pieces of a small, slightly dished flat sandstone quern in square A14 (chapter 30); and some bird bone, fish bone and shellfish fragments, the latter largely broken. There was one flake from a polished stone tool in square A13, and another fragment of a stone axe was found in 464 below in square E15 (chapter 30). An unusual clay tripartite cylinder was also found just west of 458 (chapter 28).

Immediately to the west of this concentration, but separate from it, close to the west baulk of the N Ext, there was a small, slightly mounded and tightly packed concentration of broken sherds and largely intact *Unio* shells, context 440 *(Fig. 9.26)*. This had the character of a single deposition, and it is notable that the shellfish were on the whole unbroken. There was no direct relationship with the main occupation deposit, but given that there were no obvious signs of trampling or further disturbance, it may be supposed that 440 belongs with the late phase of occupation.

There are similar difficulties in tying in the few further features found in the otherwise empty area in the west part of the W Ext, defined by the edge of the occupation deposit as already described above. Here there was no further deposit, which was further tested by a deep sondage in the south-east corner of the W Ext *(Fig. 9.25)*. But a little to the west of the main occupation deposit, some six small features were identified at the same level as 431 *(Figs 9.24–25)*. 451, 454 and 455 were small, thin, diffuse concentrations of very small pieces of red daub, roughly circular and at most 30 cm across. 456 was similar, but broader, with a diameter about 1.1 m, and containing comminuted shell and tiny broken sherds; parts of it were a more continuous stained orange, with small pieces of red daub. These might be seen as short-lived working areas or hearths, or deposits from episodes of burning (and see the SW box below). 452 appeared at first similar, a diffuse concentration of small pieces of red daub, but further exploration showed a small hole, some 7–8 cm in diameter and 10 cm deep, with a fill of red and dark soil. 453 was also first identified as a diffuse concentration of small pieces of red daub. But at a depth of 20 cm, it appeared first as a concentration of very small pieces of red daub and some smears of yellow subsoil, and then as three separate, small concentrations, 20, 25 and 30 cm in diameter respectively. In the time available at the end of the excavation, no further exploration was possible. 452 and 453 might be seen as stakeholes or small postholes, or as small fire settings of some kind. It is scarcely possible to be dogmatic, but at the least minor activity is indicated beyond the main occupation deposit. There is no way of telling to which phase of the occupation this belonged, but it might, from the level at which it was first identified, go with 431 or the latest phase of the occupation. 409–12 in the SW box, described below, belong with the main occupation deposit and not its top.

There were still considerable quantities of material in the uppermost deposits in both the CW and the CE boxes, though without the same range of finds as described above particularly for the N Ext. The whole occupation deposit thinned considerably in the SW and SE boxes. In these SW and SE boxes, the quantities of finds also diminished quite markedly, with both daub fragments and bone fragments evidently smaller in size. Some quantity of fishbone and comminuted shellfish was recorded in the SW box. In the uppermost deposit in the SE box, there was a marked concentration of red daub fragments, 306, which proved to be part of the uppermost fill of a large underlying pit, 390 *(Fig. 9.25)*.

Eleven radiocarbon dates (on ten samples) from the upper occupation deposit indicate a date in the earlier sixth millennium cal BC (OxA-9325, -10148, -9328, 9330, -9331, -12140, 12854, -X-2040-09, X-2040-08, -X-2040-07, and -13510). One equid tooth from near the top of the deposit gave a very recent date (OxA-9326). All the radiocarbon dates from the site are set out in detail and discussed in the following chapter.

The rest of the occupation deposit

The continuation of the occupation deposit was observed mainly in the area started in 1999: the N, CW, CE, SW and SE boxes. In the N Ext, a small sondage (495) in its north-west corner showed an absence of deposit altogether, quite close to the daub concentration 458; going east along the north baulk, material did not resume until square B16 *(Fig. 9.25)*. In square C13 on the south baulk of the N Ext, a small sondage (488–92) for a micromorphology sample (14631) showed the occupation there to continue at least 20 cm down as a grey-dark deposit, mottled with small pieces of red and other daub *(Fig. 9.24)*. This did not reach the base of the occupation deposit, but matches the situation found in the N box to the immediate south. A further small and shallow sondage 496 was made in square C15 for another micromorphology sample (14647). This was only 8 cm deep, but again showed the continuation of the finds-rich occupation deposit.

A larger and deeper sondage was dug in squares F15 and G15, in the east side of the N Ext, where in the uppermost deposits there had been significant concentrations of both daub fragments and sherds *(Fig. 9.25)*. A continuation was found, 498, of the daub concentration already seen in this part of the N Ext, within the upper spit 481 of the sondage, and consisting of rather amorphous large fragments. Successive spits 481, 497 601 and 603 showed continued dark archaeological deposit quite rich in finds of sherds, daub fragments, animal bone and shellfish, to a depth of about 40 cm below the level of 464 (that is the level reached over the most part of the N Ext). 603 was a little lighter and stickier, with fewer finds. Within 497 and 601, and seen best in the north section of the sondage was a small deposit, 604, perhaps roughly oval in plan, and only some 10 cm thick, of yellow silt overlain by red silt, contrasting quite strongly with the darker matrix around it. Unless the sondage investigated a shallow pit, it seems likely that this represents the continuation of the main occupation deposit, and significantly its thickest part found, close to the highest part of Ecsegfalva 23B. 604 can perhaps be seen as a small hearth.

In the W Ext, another small sondage was placed over the linear daub concentration 438 *(Fig. 9.25)*. Very few finds were found to the west of 438 in three successive spits 486, 493 and 499, evidently confirming the reality of the edge of the occupation deposit already noted and discussed. There was virtually nothing in 499, at a depth of c. 20 cm below the level of 469 (the level reached

Fig. 9.31. The main occupation deposit in the North box, in context 344

in the main part of the W Ext). 438 ended within the top 10 cm spit 486, as a spread (up to 40 cm across in the portion exposed) of quite large daub fragments with reed impressions. This was therefore more diffuse at its base than 305 noted above, but of similar shallow depth.

The best remaining impression of the main occupation deposit comes from the N, CW and CE boxes. The best recording was in the N box. Here successive spits continuing below the uppermost deposits (354, 376, 400, 424, 465, 470, 475, 476) showed familiar, quite dense concentrations of daub, animal bone, shellfish, and sherds *(Fig. 9.31)*. In the eastern part of the box, down to spit 400 but especially in 354 and to some extent in 376, the generally dark-grey to grey-brown deposit was markedly lighter, matching the silty quality seen in the uppermost deposits in the CE box, noted above. There were many finds here, including unbroken shellfish. Unbroken shellfish were a striking component of 375 in the extreme north-east corner of the N box in square G11. Here the lower part of an inverted bowl (7588) lay over a mass some 40 cm across and some 5–6 cm thick of *Unio* shell (7589); this was seen within 354, above the level of 376 *(Fig. 9.32)*. There was no sign of a pit or other cut feature, and this perhaps, like 440 noted above, could be seen as a single act of deposition not subsequently disturbed. The more or less unbroken shell in the east part of 354 and 376 might indicate a midden area. In 376 the range of finds was particularly striking, and included a large perforated and decorated clay weight (10033) and a substantial portion of antler, as well as daub fragments, sherds, shells and animal bone. The quantity of finds gradually diminished in the lower spits, with generally more in the eastern part of the box than elsewhere.

Despite careful search, no surfaces as such could definitely be seen within this deposit, either in plan or section. 400 was defined as a largely finds-free level of fine compacted grey to light grey deposit, and two micromorphology samples (10781–2) were taken through it, which may indeed suggest something in the nature of a surface of some kind (see Macphail, chapter 11).

Few features were found either, despite careful search also particularly for postholes. 360 was a near-circular concentration of crushed and broken pieces of red daub (not bigger than 5 cm),

Fig. 9.32. Pot inverted over shells in context 354

Fig. 9.33. Large daub fragments, context 349, *in situ* in the CW box

some 50 cm in diameter and up to 15 cm thick; this was seen within 354 and continued into 376 and 400. There was no sign in underlying spits of any posthole or pit below the daub concentration, which might be taken as a short-lived small hearth setting or work place, broadly analogous to 456 and 604 noted above. Darker patches 401 and 446 were closely examined but were

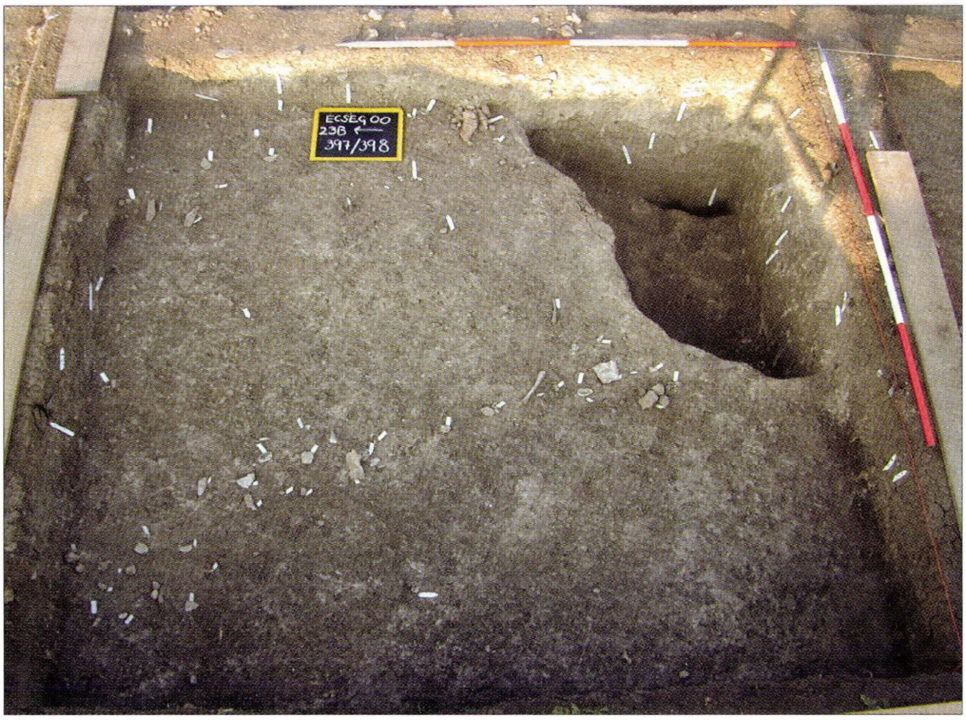


Fig. 9.34. Context 404 at the base of the occupation deposit in the CW box

considered to be the remnants of animal disturbance. There were further small, quite compact concentrations of daub 361–6, in 354, but there was no obvious regularity in their spacing nor any sign of postholes or stakeholes beneath them.

In the CW box, the western part of the occupation deposit appeared slightly heaped in section, though this was scarcely evident during excavation, and the same edge to the occupation deposit as was more visible in the W Ext, as described above, could probably also be seen in the westernmost part of the box. A notable concentration of very large pieces of daub, 349, was found in the lower part of the main occupation deposit, in a position that proved on further excavation to mark the top of the pit 394/395/390 *(Fig. 9.33).* In the CE box the occupation deposit (343, 352) was marked by continued concentrations of grey-white silty deposit, as well as by signs of animal disturbance (as can be seen in the main N–S section on the east side of the trench). In both boxes there were plentiful finds of sherds, shells and bone.

At the base of the occupation deposit in the CW box, when finds had otherwise more or less petered out, there was a thin line, 404, running roughly on the same SE–NW axis as the edge to the occupation deposit noted above, but inside it, composed of small animal bone fragments, sherds and shell *(Fig. 9.34).* No stakeholes or other features were found beneath this, despite careful search. The area to the west of 404 appeared to be slightly darker than that to its east. It is hard to envisage what this line represents, but it may be to do with the limits of occupation in this part of the site, perhaps material that came to rest against some kind of feature or structure not otherwise detectable. Its orientation is reminiscent of that of 305/438 much higher in the deposits to the north (see above).

The occupation deposit was sampled for micromorphological analysis in the east section of the CW box (10784) and elsewhere.

In the SW and SE boxes, the main occupation deposit was markedly thinner, as well as having a less dense distribution of finds. 355 was a small concentration of finds, including small bones and sherds but principally consisting of shells. 409–12 were diffuse concentrations of

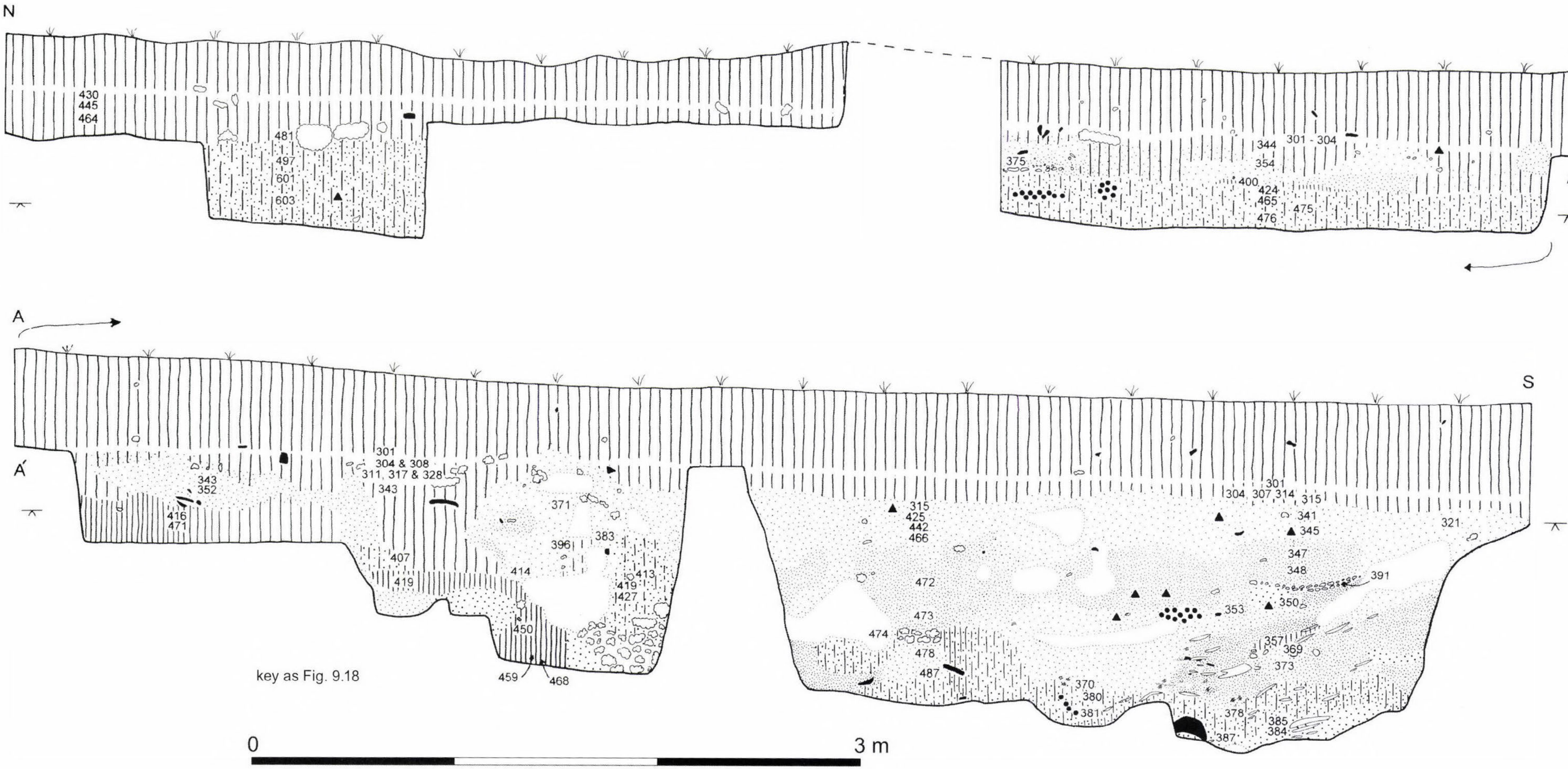


Fig. 9.35. The main section on the east side of Trench B

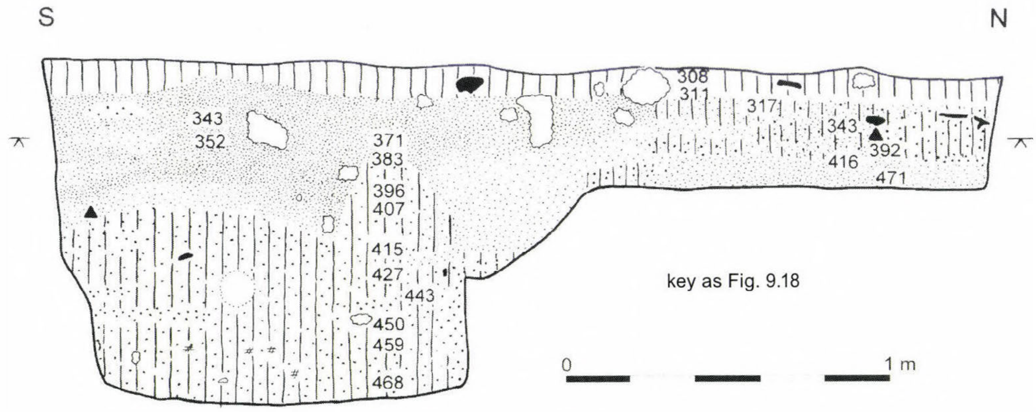


Fig. 9.36. The west section of the CE box in Trench B

small reddened daub pieces within the main occupation deposit, not more than 60 cm across, only a few cm thick and without further visible structure, like 456 already described in the W Ext. There were no signs in or under these features of stakeholes or postholes. They could be interpreted similarly to 456, discussed above, but it can be noted that here they do not belong to the very latest phase of occupation.

At the top of pit 393 and seen only in section there were two separate very thin dark lenses, 402, within a grey matrix. These were perhaps part of the pit fill, but might just be an indication of separate episodes of occupation. They were not seen in plan, however, and further excavation to the south would be required to examine them further. These were sampled for micromorphological analysis (10783).

Six radiocarbon samples from the main occupation deposit indicate a date in the earlier sixth millennium cal BC (OxA-11845, -12858, -9332, -13511, -11982, and -12859). A seventh sample from 351 in the CW box suggests on its own a rather earlier, pre-Neolithic date (OxA-12857). Like the others, this is discussed in chapter 10 below and subsequently.

Pits

Two pits were found, both within the southern part of the area started in 1999, one in the SW box, 393, and one in the SE box and extending into the CE and CW boxes, 390/395/394. (390 refers to the part of the pit in the SE box, 395 to that in the CE box, and 394 to that in the CW box. This can be treated as ultimately one feature, but see also below.) Both were overlain by part of the main occupation deposit, here much thinner than in the other parts of the trench, as described above *(Figs 9.35–38)*. It will be remembered that only the top of the occupation deposit was excavated in the N Ext and W Ext, and the density of pits in the area of 23B thus remains to be established by excavation in the future.

The relationship of the two pits found is unclear. It is possible that 393 is a little later than 390/395/394, since it appeared relatively a little higher within the occupation deposit, but this assumes absolutely level surfaces. Perhaps the most that can be said is that both appear to be early or at the least relatively early in the overall sequence. In neither case is it possible to be more precise than that.

It is possible, taking the evidence of the CW box into account, that some occupation had started in that area before the digging of 394/395/390, as represented by the lowest finds including 404 described above. The lowest occupation levels in the CE box, 452 and 416/471, might also be seen as either spilling into the pit or to be cut by them. The latter appears to be the case as seen in the main N-S section on the east side of the trench, though the situation is confused by animal disturbance. The situation is less clear in the undisturbed section on the west side of the CW box, where the basal occupation deposit grades into the upper pit fill and it is hard to distinguish where one ends and the other begins. It is possible, however, that the pit 395/394 cuts an already existing thin accumulation of occupation deposit.

A further complication is that as described below the northern part of the pit 395/394 (as seen in the CE and CW boxes) had a somewhat different fill to that of the southern part 390 (as seen in the SE box). The baulk between the CE and SE boxes was not removed due to lack of time, though this could have been illuminating. The base of the pit was also different in these two different areas, as described below. It is therefore possible that 390 and 393 were primary features within the early history of the site, with 390 being recut at its northern end by 394/395, after some occupation deposit had accumulated in that area. A further possibility is that 390 and 393 belong to an area outside the main focus of initial occupation, and were cut only after the occupation had been in place for some time, and that the putative recut represented by the fill of 395/394 is a further episode.

These questions will be further discussed below.

Four radiocarbon dates from Pit 390 (OxA-11850, -10501, -10500 and -9333; OxA-12855 is an outlier) form a consistent series within the Bayesian model presented in the next chapter and place its fill in the earlier sixth millennium cal BC. Four radiocarbon dates (OxA-11868, -11849, -12655, and -12654) from Pit 393 also indicate a date in the earlier sixth millennium cal BC, but in this instance there are inversions of date compared to stratigraphic order, perhaps explicable by the deposition of old material. Nonetheless, for purposes of presentation and for the ordering of differing categories of finds the two pits have been treated as early events (and see *Fig. 9.40*).

390/395/394

Taking all parts together, this appears to represent a pit at least 5 m across and up to 1.7 m below the modern surface (*Figs 9.25, 9.35,* and *9.39*). It is perhaps more oval than circular, though because of the limits of excavation this could not be established. The southern part 390, seen in the SE box, was cut irregularly into the yellow loessic subsoil, its sides sloping and its lowest parts uneven and with small embayments or hollows. In the northern part, however, the lowest portion of the pit 395 had a very regular curved edge, seen also as 394 but in very cramped conditions of excavation in the CW box, forming a sharp junction with a flat base extending across the base of the CE box, in both cases cut into yellow loessic subsoil. This is a distinctive contrast.

The largest portion of fill was seen in the SE box, and description can best be referred to the main N–S section along the east of the trench *(Fig. 9.35)*. Some animal disturbance can again be noted. 390 was investigated over three seasons, initial exploration being followed by full excavation of adjacent portions in 2000 and 2001.

The primary fill of the southern part of 390 consists of alternating runs of dirty yellow loessic material interspersed with small lenses of dark to dark brown material, seen especially in the southern part. Above this there was more uniform brown silty material, at the southern side of the pit seeming to come in at a slight pitch from the adjacent edge. At the lower part of this run, the same sort of deposit continued but markedly darker, and interspersed with small ashy lenses and charcoal flecks. Above this level (so above 357 and 474) was a substantial deposit, reaching to the infilled top of the pit, of variously brown to grey (and drying lighter) silty material. This included some pieces of daub, in the case of 391 forming a more concentrated concave lens a few cm thick within the deposit.

There were small quantities of finds throughout the fill of the pit, consisting principally of sherds, shells and bone. In the upper deposit described above, there were two small finds concentrations which may represent single depositional events. 346 within 345 consisted of a pot base and other sherds, overlying a number of *Unio* shells. 353 was a larger concentration predominantly of sherds, with also shells and some pieces of bone; there were also a few small daub fragments. This material was scattered over approximately 1 m square, the sherds lying at a slight tilt as though deposited on a slightly sloping surface.

Basically the same pattern can be seen in the northern portion of 390, that is, that portion of the pit within the SE box. However, fewer small basal lenses can be noted, and a greater proportion of deposits of yellow loessic material. This is partly reflected in the main N–S section on the east side of the trench, but was also more prominent in the transverse section across 390 created by the northern end of the portion investigated in 2000. Here there were more substantial amounts of yellow loessic material (420), including quite high up in the fill, and merging with the daub deposit 306 above already noted; some animal disturbance was noted here. Micromorphology sample 10785 was taken to examine this deposit.

Two main episodes can be suggested in the filling of this part of the pit. The primary fill occupies only the lower portion of the pit and could be seen as the result of erosion of the pit sides, cut into the loessic subsoil, interspersed with small lenses of eroded or perhaps inwashed occupation material, including some sherds and bones. Above this was a substantial of brown to grey silty material, much of which, and perhaps most notably the upper part, could have been dumped. The lower part, on the basis of the small lenses, might be seen as having been dumped in successive short episodes. Some of the irregular angles and surfaces in the lower part of the fill of the northern part of 390 are consistent also with episodic dumping. 346, 353 and 391 could also be similarly interpreted, each disposed on a sloping, slightly concave surface, but the depth and relative uniformity of the second part of the pit fill could suggest a much shorter timescale. The greater amounts of yellow loessic material in the northern portion of 390 are also best explained as dumping, again perhaps most plausibly over a shorter rather than a longer timescale.

The fill of 395/394 in the CE and CW boxes was rather different. The base and curved edge of the pit here have already been described and noted as different: more definite and sharper. An irregular edge was noted in the CW box, which this more definite edge in turn cuts. In the field we were inclined at one stage to think that the irregular edge and its fill (372, 377) were simply the product of over-excavation, but it may be more convincing to see these as the limits of a primary, less regular feature and its fill, equivalent perhaps to the basal and primary parts of 390. The fill of 395/394 lacked any indication of the small basal erosional lenses seen in 390. It was much more heterogeneous throughout *(Figs 9.36–38).* A certain amount of animal disturbance obscures the character of the fill in the main N–S section on the east side of the trench, but the N–S sections between the CW and CE boxes, and the E–W section on the south side of the CE box show the main features clearly. There was a succession of dark soil deposits flecked with yellow clay and very small pieces of daub, interleaved with patches of more yellow loessic material, and in one place a substantial deposit of large fragments of burnt daub (here rather soft and fragile). This heterogeneity was also seen in plan within the pit.

In overall terms, the nature of this fill in the CE box was substantially different to that seen in the northern part of the adjacent SE box. There are perhaps two main possibilities. On the one hand, this fill of 395/394 could be seen as another portion of irregular and perhaps short-lived dumping into the pit, as already discussed above. On the other hand, this concentration of somewhat different material could be taken to indicate a recut portion of the pit, though no precise edges could be seen within either the CE or SE boxes. The quite substantial baulk left between these two units might of course obscure the situation. This second possibility is certainly strongly consistent with the observations above concerning the edge and base of the 395/394 pit,

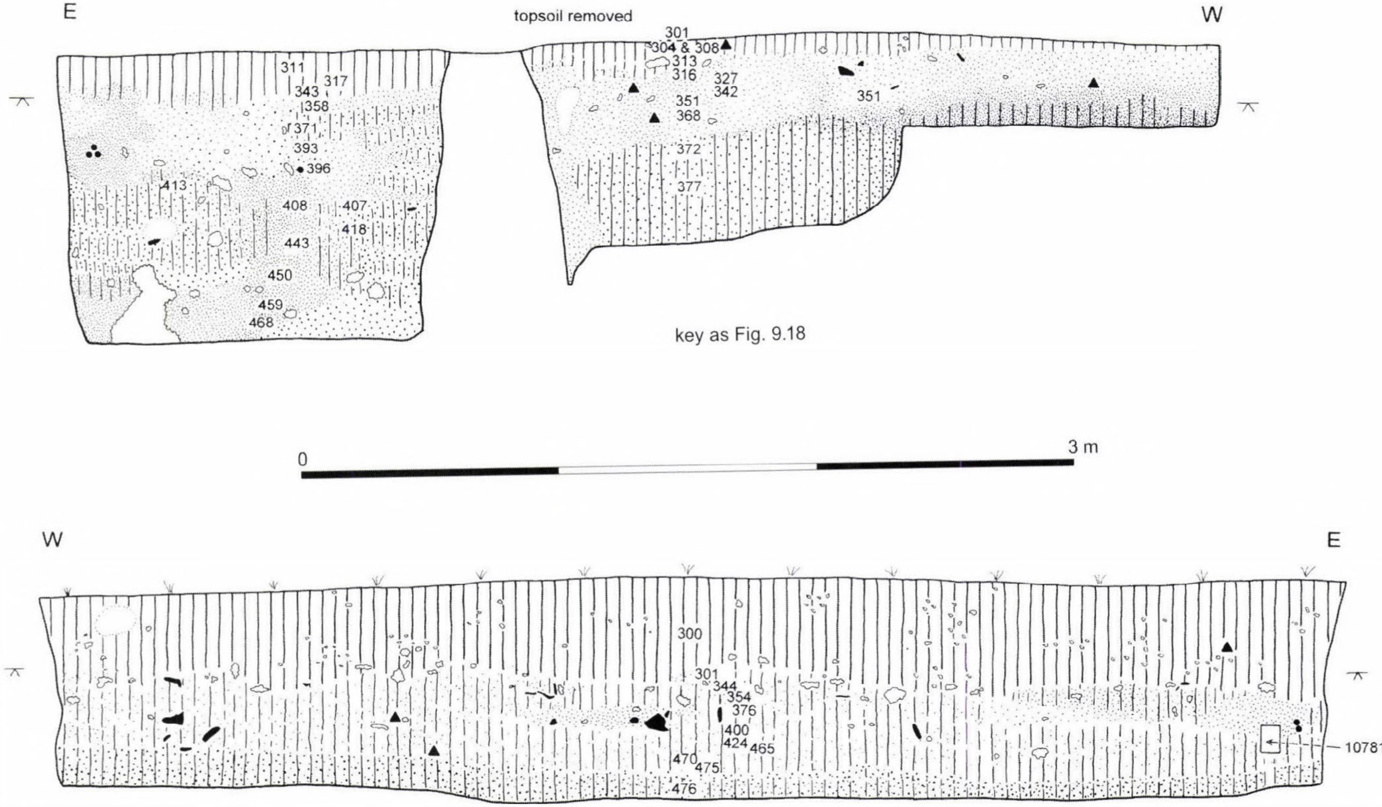


Fig. 9.37. Top: the south section of the CE and CW boxes; below: the north section of the North box

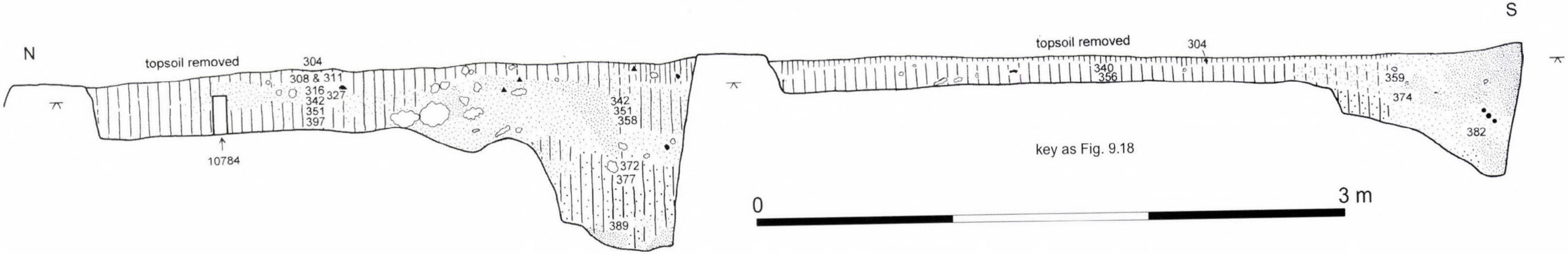


Fig. 9.38. The east section of the CW and SW boxes

Fig. 9.39. The fill of pit 390

and the possible relationship between sharp curved edge and earlier irregular edge and fill in the CW box noted above.

While a thin spread of occupation material could be seen in the SE box over the 390 pit, suggesting a primacy for the pit, the situation is less clear in the CE and CW boxes. The distinction between base of the main occupation layer and the top of the pit fill was not easy to make. The main N–S section on the east side of the trench suggests that the basal context 416 could have been formed before the cutting of the pit, though in the other N–S section (on the west side of the CE box) this is less compelling, and the occupation layer as a whole could be seen as overlying the infilled pit.

Overall, this complex of features must be seen as early in the sequence of activity at Ecsegfalva 23B. Whether it entirely precedes any occupation is unclear. Its fill reflects a series of events, including a significant episode or episodes of dumping of material itself similar to that which constitutes the main occupation layer. There may be a further episode reflected in the possible recut and further dumping at the northern end of things. Whether or not the details of the history of this pit complex can be precisely and exactly traced, it appears that the complex reflects a series of events, which contributes significantly to a sense of a cycle of occupation *(Fig. 9.40).* This will be discussed further below.

Micromorphology samples were taken from 390: 5771 from the upper fill, and 10779, 10778 and 10777 from the lower fill, from the level of 350 downwards. 10785 was taken over the yellow loessic material 348/420 in the transverse section noted above. 5769 was taken in the CE box from 301 down to 325/335, thus principally through the occupation deposit.

393

The excavation of Ecsegfalva 23B only clipped the edge of pit 393, and it cannot be determined whether it was a small or a large feature, even from the geophysical survey. 393 was recognised as excavation of the main occupation layer in the SW box progressed, and it is clear that occupa-

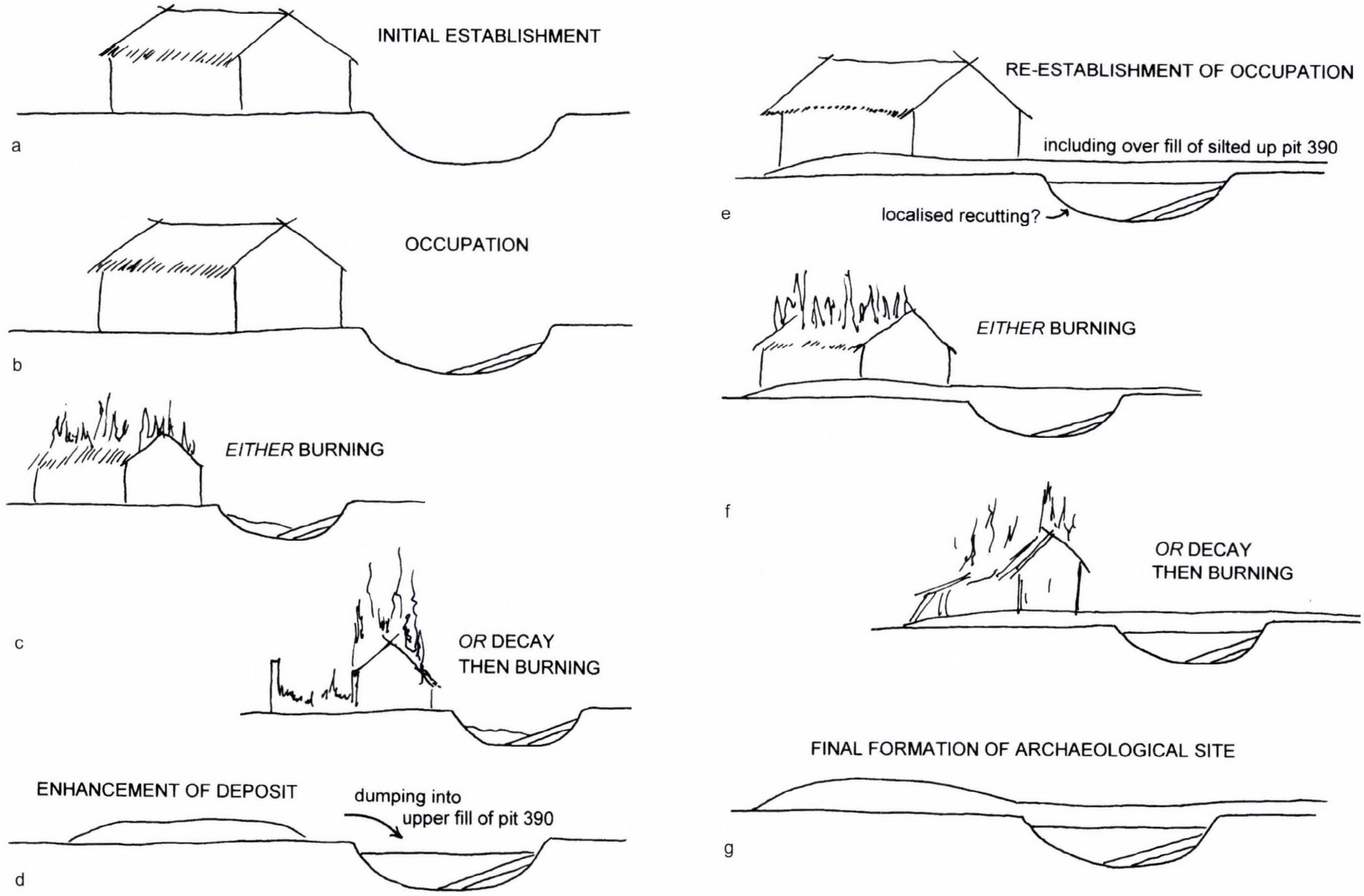


Fig. 9.40. Summary interpretation of principal formation processes in Trench B

tion material covers it. As with 390, it could not be definitively established whether 393 preceded all occupation in this area, though like 390 it can be presumed as an early feature.

393 was defined as having quite steeply sloping but again irregular sides (*Fig. 9.38*). Its fill (359, 370, 374, 382, 426) consisted of quite fine grey silt, and there were modest quantities of sherds, animal bones, small pieces of daub and shellfish. This could probably be seen as backfilled material, though with so little of the feature exposed there is little certainty on this. Two very thin lenses (402) within the occupation material immediately over it have already been noted above, and micromorphology sample 10783 was taken straddling these.

Trench 23A

Following the geophysical surveys of 1998 and 1999, Trench 23A was laid out to investigate an area of prominent geophysical anomalies on what appeared to be, from the geophysical evidence, the periphery of the Ecsegfalva 23 site (*Figs 9.8* and *9.14*). As the location of the trench was in permanent grassland, this position relative to other concentrations of features and surface finds could not be further checked. Trench 23A was planned from the outset as a small sondage: 5 by 5 m *(Figs 9.41–42)*. It was not completely excavated, the Neolithic levels of its south-east quadrant remaining undug. The trench was initially dug by hand, to establish the stratigraphy, and it rapidly became evident that there was a thick deposit of post-Neolithic material overlying the Neolithic level. This may have been deposited in comparatively recent times as part of agricultural improvement and drainage operations, though the deposit contained relatively abundant finds of Körös pottery, presumably derived from elsewhere in the Ecsegfalva 23 occupation. At any rate, the Neolithic level within Trench 23A began at a depth of around 1 m below the modern grassed surface.

Fig. 9.41. The excavation of Trench A

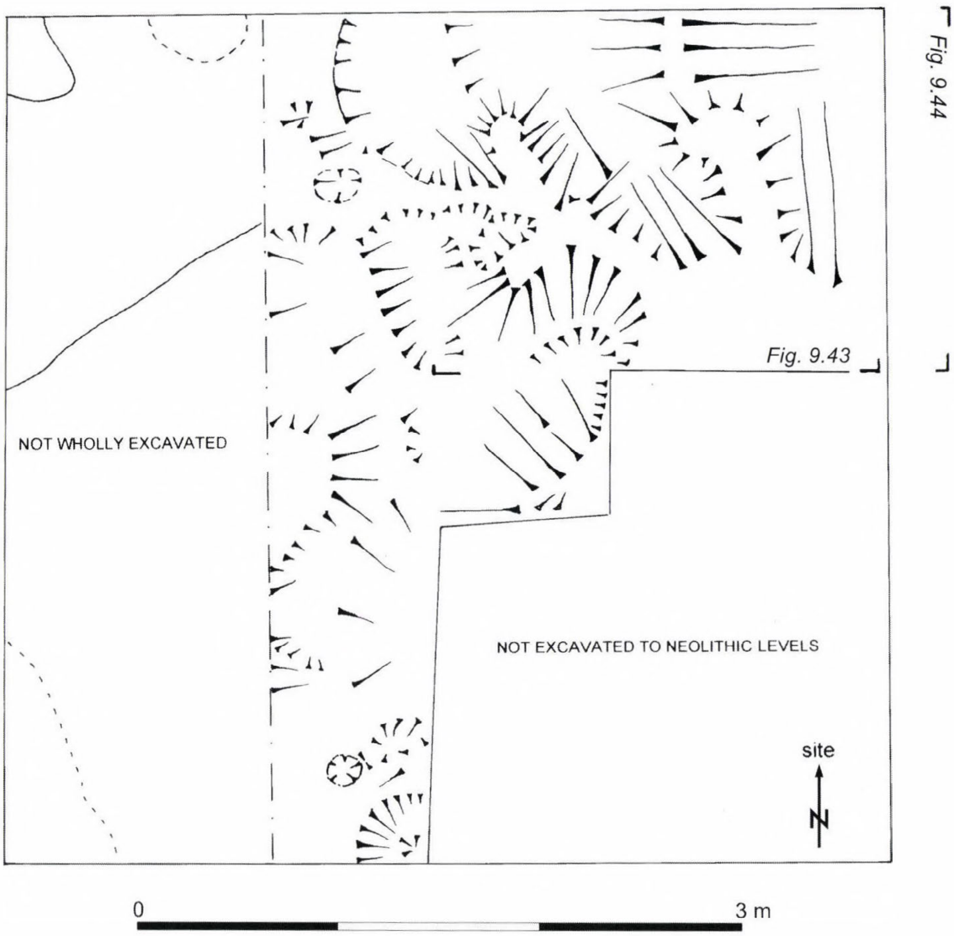


Fig. 9.42. Subsoil features and extent of excavation in Trench A

Exploratory excavation began in the south-west quadrant in 1999, and with the discovery of a human skeleton at its northern edge was extended into the north-west quadrant. The 2000 season saw the further opening of the north-west quadrant, and the opening of the north-east quadrant. At this stage the post-Neolithic deposit was removed with the help of a machine. The underlying scoops or shallow irregular pits thus revealed were not completely excavated. Those in the north-east quadrant were, with a small portion of the south-east quadrant, in an area rich in carbonised plant remains. A strip along the east side of the south-west and north-west quadrants was also fully excavated, leaving a substantial portion of the continuation of these features in the north-west quadrant unexcavated.

Below a grey ploughsoil (101), the post-Neolithic deposits were dark, heavy, clayey soils (102–3). At a varying depth of around 1 m, a slightly less dark but still clayey soil was recognised (104). The difference was easier to see in section than in plan, and there was no obvious or immediate increase in the number of finds to indicate the definite presence of the Neolithic level. Finds above as well as at and below this level were overwhelmingly of the Körös culture, though some can be identified as AVK (see Oross, chapter 27). Micromorphology samples were taken which straddle this level: 1240 immediately adjacent to the burial, and 1241 in the southern wall of the trench (at its western end). Sample 1412 was also taken through the scoop fills of context 136 and the deposits immediately above them *(Figs 9.43–44).*

The Neolithic level had a number of sherds, but very little other material. There were small pieces of comminuted red daub, but nothing of the abundance of daub or other materials seen in

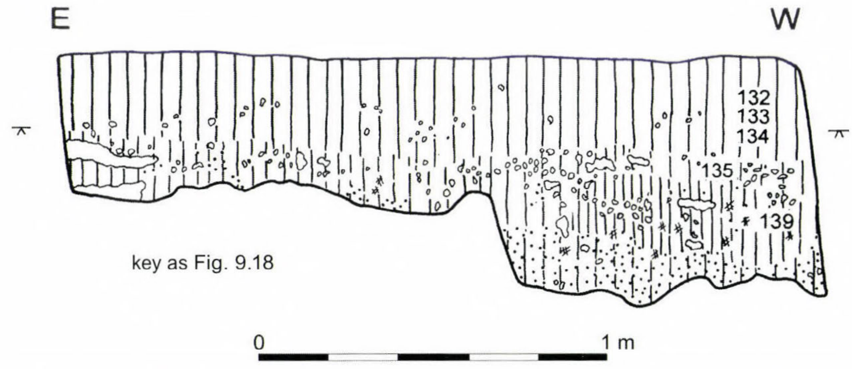


Fig. 9.43. South section (Neolithic contexts) of the NE quadrant of Trench A

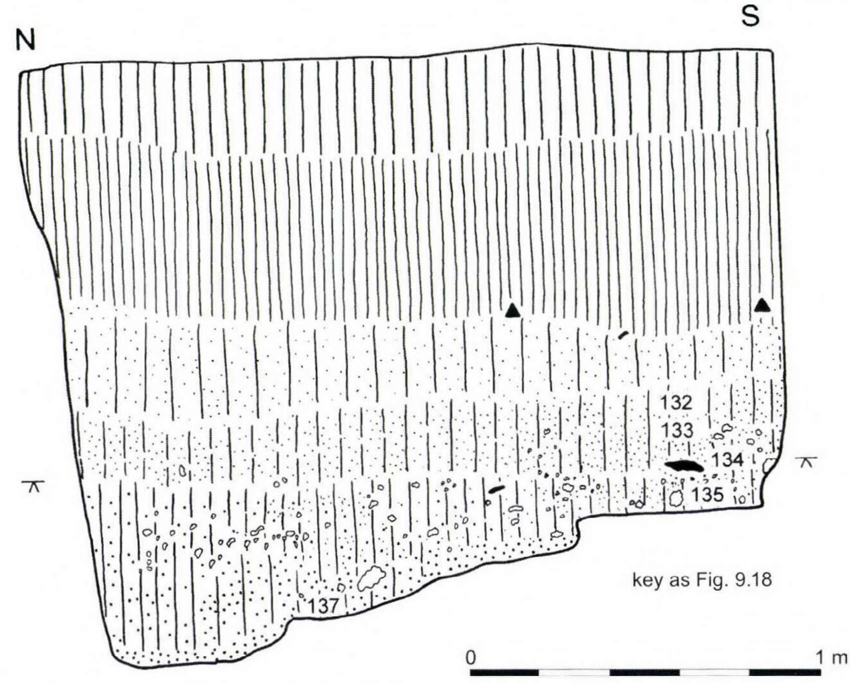


Fig. 9.44. East section (with numbered Neolithic contexts) of the NE quadrant of Trench A

Trench 23B. The burial appeared to lie on or in this surface *(Figs 9.45–46)*. Given the nature of the deposit, it could not definitively be established that it lay precisely on the surface itself, but it could be seen that it did not lie within a cut or grave. The skeleton was that of an adult woman (see Guba *et al.,* chapter 25, for further description). It lay on its left side, with its head to the south, facing west; the legs were very tightly flexed, and the arms were held close to the body, apparently crossed over one another, with hands in front of the face. There were no artefacts which must definitively have been deposited with the skeleton, and here as elsewhere at this level there was a scatter not only of Körös culture but also of AVK sherds, which were taken at the time of excavation to date the skeleton to the Körös culture. A small stone bead, perforated on its underside, was found in the context below the skeleton (1172 in 108). A radiocarbon date was subsequently obtained from the skeleton of the later sixth millennium cal BC (OxA-10678), which indicates that the person belonged to the AVK ('Alföldi vonaldíszes kerámia', the Linear Pottery culture of the Great Hungarian Plain) rather than to the Körös culture itself. The implications of this dating are discussed in the final chapter.

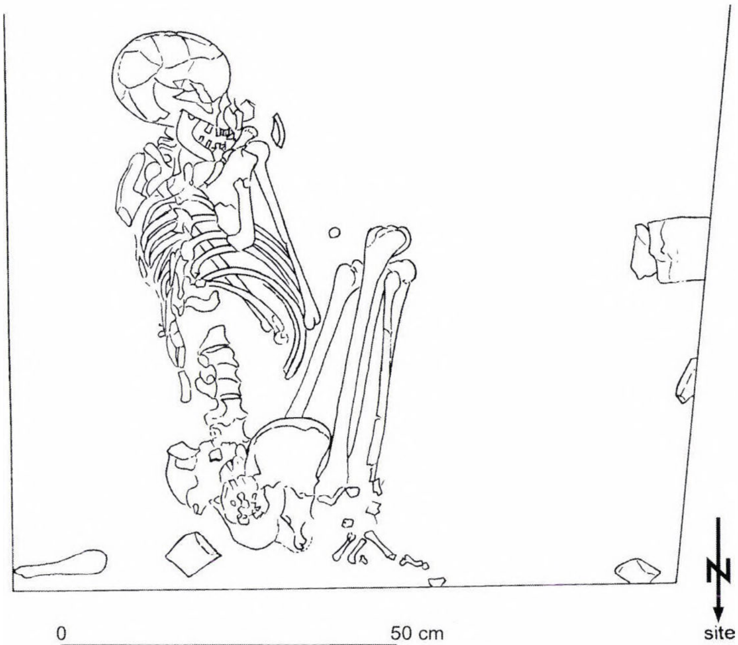


Fig. 9.45. The human skeleton in Trench A

Below the level of the skeleton, the Neolithic soil graded into the fill of underlying scoops or very irregular, shallow pits. As can be seen from the plan *(Fig. 9.42)*, these were of varied form, from circular to oval, with small ridges left in between. It was impossible to see whether there was a succession of features, though that is likely enough. The plan also indicates an area within the incompletely excavated north-west quadrant which may have lacked these features, and the edge thus recorded might correspond to the limits of the recorded geophysical anomalies. The fill of the scoops was a dark, clayey deposit, with some admixture of comminuted pieces of red daub, and localised concentrations of small charcoal fragments and charcoal staining. The latter were encountered particularly in the southern part of the north-east quadrant, and proved to be rich in carbonised plant remains including cereals. For that reason, a further portion of the adjacent south-east quadrant was excavated at the end of the 2000 season, in order to increase the carbonised plant remains sample (for further description and discussion, see Bogaard *et al.,* chapter 23). None of the scoops was very deep, and the lower fills, particularly in the strip excavated across the south-west quadrant, were often quite yellow, as if the fill was accumulating together with erosion of the loessic subsoil. Apart from carbonised plant remains, there were small quantities of sherds and animal bone, and very occasional shells.

Fig. 9.46. The human skeleton in Trench A during excavation

Four radiocarbon dates of the earlier sixth millennium cal BC were obtained on cereal grains from the fill of the scoops (OxA-9334 and OxA-9335 from 113, and OxA-11863 and OxA-11871 from 136). A very similar date was also obtained on animal bone from the same context (OxA-11983 from 135). These are set out in detail and discussed in the next chapter.

Trench 23C

Trench C was begun in 2000 and completed in 2001. It was laid out some 40 m to the south of Trench B, on the edge of a small cluster of magnetic anomalies and in an area where there were abundant surface finds; this was also slightly lower-lying than Trench B, by some 30 cm (*Figs 9.1, 9.8,* and *9.14*). The area between the trenches was devoid of magnetic anomalies, and slight differences in the modern vegetation might suggest the presence here of a cross-channel connecting backswamp behind Ecsegfalva 23 with the Kiri-tó. An area 5 by 15 m was originally opened by machine, to compare and contrast the situation seen in Trench B. The first opening provided part of the answer. Beneath a shallow topsoil, there was a variable surface, generally dark grey and clayey, with both sherds and some animal bone visible, but lacking the density of finds seen from the outset in Trench B. A small portion of the south end of Trench C was further investigated by machine, sufficient to show a few finds of sherds and daub in approximately 20 cm of dark clayey soil above greenish-yellow subsoil. There was clearly no preserved cultural layer here as in Trench B.

After further cleaning of this surface, we recognised that we had insufficient resources for an excavation on the scale of Trench B. Two areas 2 by 2 m were selected for further investigation. In VW7-8 a small concentration of daub fragments was found, with a few sherds *(Fig. 9.47).* This

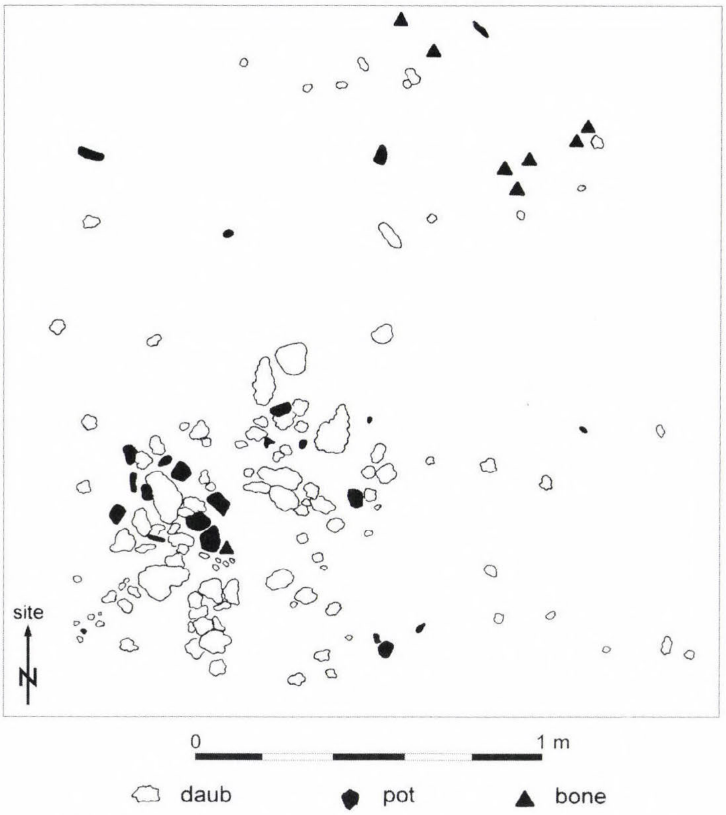


Fig. 9.47. Excavated features in squares VW7–8 in Trench C

was excavated to a depth of only c.10 cm below the exposed surface, and the clear impression was of very little material, apart from the daub concentration, matching what had already been seen nearby in the inspection slot at the south end of the trench.

In XY14–15 at the north end of the trench, however, a different situation was encountered *(Figs 9.48–50)*. This 2 by 2 m sondage was laid out in an area of noticeably dark, clayey soft soil, richer in finds including animal bone than visible elsewhere on the machine-exposed surface. Successive spits (506–512, 515) were dug through this, with the density of finds rapidly increasing. The matrix of the upper deposit to a depth of some 50 cm below the exposed surface remained a dark, clayey soil; at this depth on the north and south edges of the sondage small patches of very dirty yellow clay were seen, such that it was assumed at the end of the 2000 season that the feature represented some kind of narrow channel into which finds had been deposited. Finds included abundant sherds, animal bones, many of them substantial, a largely intact sheep skull, a piece of stone, a worked bone point, some perforated clay weight fragments and some daub pieces.

In the event, further investigation in 2001 showed that the dark clayey soil overlay a further deposit of pale yellow compacted silt, in places slightly redder, and with an admixture of very small daub fragments, and in others dirty and mixed with grey soil. This was some 40 cm thick; the deposit in the centre of the sondage tended to be a little darker and dirtier than the rest. Dirty yellow clay on the north side appeared to represent an edge to a shallow feature, comparable perhaps to the shallow scoops seen in Trench A, but whose fill resembled more the dumped backfill of pit 390 in Trench B. Micromorphology sample 9641/9644 was taken to investigate this sequence. Finds in this lower set of deposits included sherds, daub fragments, perforated clay weight fragments, occasional shells, obsidian and limnoquartzite pieces, and a fine bone spoon with thick pointed handle (9513 from 529). Finds were mostly concentrated in the centre of the sondage. Some small pieces of charcoal were found, and flotation recovered some cereal remains (see Bogaard *et al.,* chapter 23 for further description and discussion).

Three radiocarbon dates on samples from the upper, middle and lower deposits place this occupation in the earlier sixth millennium cal BC (OxA-10505 from 515, OxA-11984 from 521, and OxA-12860 from 528). These are set out in detail and discussed in the next chapter.

Almost at the end of the excavation, several small teeth of a child were found right at the base of the east wall of the sondage, and a small extension (1 m by 0.8 m) was made, with considerable haste, to investigate these further. At the base of this extension, and level with the rest of the base of the scoop otherwise excavated, further teeth were found, along with a weathered portion of cranium and some feet and hand bones (context 546) (see Guba et *al.,* chapter 25, for further description). An animal longbone (9681) was found immediately above. This appears to represent either a child burial or a deposit of selected child remains. The deposit lay at the base of a generally dark matrix, not in the paler silty fill of the lower scoop, and had presumably cut through that at a later date; in plan it was little more than 50 cm across. It was observed in the extension to have cut the upper dark deposits as well. Finds from the fill of this cut (536, 539, 541, 543, and 545) included Körös sherds. The feature was not obviously visible in the east section of the XY14–15 sondage, though dirty, mottled yellow clay seen quite high in the upper dark deposits in 2000 might relate to this event.

A radiocarbon date (set out in detail in the next chapter) on one of the child's bones placed this deposit in the later first millennium cal AD (OxA-12141).

Without wider excavation, it is hard to evaluate this set of observations in detail, though they provide a useful first sample from this area. The initial investigation of Trench C appears to confirm the lesser intensity of occupation in this part of the site, compared with what was found in Trench B. The features excavated in XY14–15, however, appear to suggest both a sequence of activity and some concentration of deposited material, including substantial animal bones and structural daub. A shallow scoop may have been filled with material derived from daub-covered

Fig. 9.48. The excavation of squares XY14–15, context 515, in Trench C

Fig. 9.49. The excavation of squares XY14–15, context 524, in Trench C

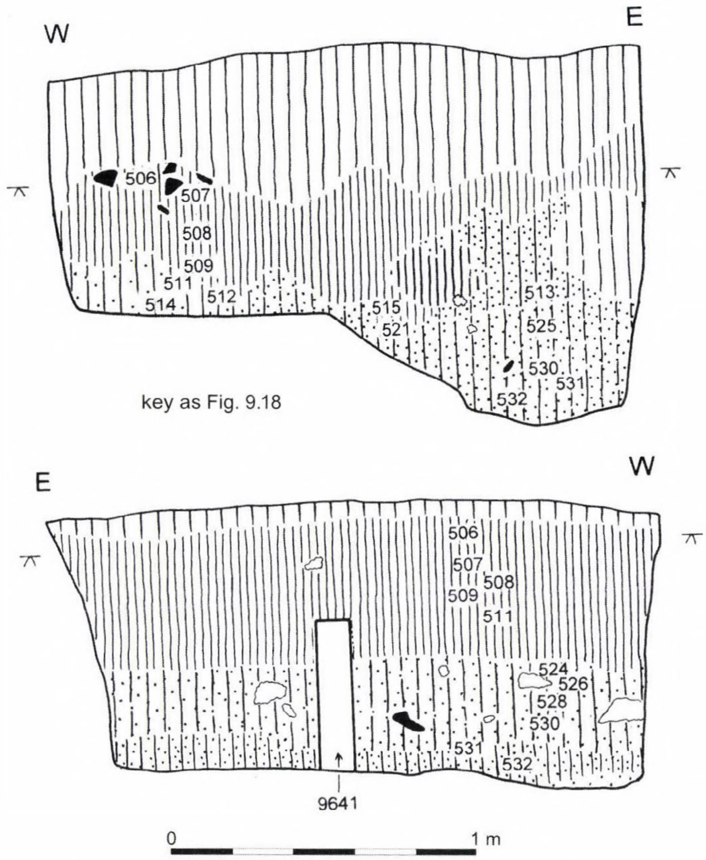


Fig. 9.50. Sections of squares XY14–15 in Trench C

structures, a deposit which contained a wide range of finds. Deposition of a rich assemblage of material continued above the filled scoop, in a puzzling dark, clayey soil. What may this represent? Perhaps the surest indication is the difference to the situation observed in Trench B. There was no sign here of the same kind of cultural layer seen in Trench B. The dark clayey soil might have accumulated in a hollow left in the top of the scoop, or might perhaps represent more sporadic occupation in wetter conditions. Nonetheless, the density of finds encountered through all the successive spits remains striking. Without further excavation, this question can hardly be answered, but what was observed underlines that a lesser intensity of geomagnetic anomalies cannot be equated with a near-absence of occupation, and that occupation is not necessarily to be classed as wholly different in character to that seen in Trench B. It is the concentration and accumulation in Trench B which stands out.

Ecsegfalva 18A

As already described, the ridge along the southern inner edge of the Kiri-tó was tested by geophysical survey in 1998 and the beginning of the 1999 season. From the scattered small anomalies thus revealed, one small cluster (A1) was selected for sample excavation and was dug by hand in hot and dry conditions. Trench 18A was laid out as a 5 by 5 m sondage, in an area where additionally some surface sherds had been found during geophysical survey. From the outset, as grey compacted topsoil (101) was removed below the lucerne crop, incised AVK sherds were found, along with one or two pieces of obsidian, and a few animal bones.

Fig. 9.51. Daub concentration in the test excavation of Ecsegfalva 18A

After initial clearance, an elongated concentration of daub (102) appeared in the base of the topsoil at a depth of about 35 cm below the modern surface, along the western edge of the cutting. This was some 1.8 by 0.6 m, consisting of large reddened daub fragments up to 13 cm long with characteristic reed impressions, as well as of much smaller fragments, and formed a layer some 10–15 cm thick *(Fig. 9.51).* Now excavation was confined to this portion of the sondage. Below the daub concentration there was further grey to dark clayey soil (103 and 104), largely free of finds, above a brown silty clay (105) which was taken to be the top of the natural, 50–55 cm below the modern surface. No other features were seen in the 5 by 2.5 m area fully excavated.

Discussion

This portion of site 18 at least appears to belong to AVK rather than Körös culture occupation. Without wider excavation, it is impossible to say precisely what the daub concentration represents, but it is of course possible that it is to do with the remains of some kind of standing structure. No postholes were seen in the very small area opened. Although a negative result, it can at least be said with some confidence that there was no Körös culture occupation in this immediate location.

Fig. 9.52. Pits in the modern section through Ecsegfalva 16

Other sites around the Kiri-tó

The setting and geophysical survey of sites 16, 20 and 21 have already been described above. No further fieldwork was undertaken at sites 20 and 21. At site 16, in the section created by modern land-use immediately adjacent to the area covered by geophysical survey, it was possible to observe a series of archaeological features, principally two large Körös culture pits, dug into the subsoil below some 30–40 cm of topsoil and overburden *(Fig. 9.52)*. From these had eroded a substantial quantity of sherds and animal bones. A polished stone axe was also found in this area. The fill of the pits appeared in section to consist principally of grey material, resembling the unburnt fill of pit 390 in site 23B. There were concentrations of charcoal flecks and other carbonised material, amongst which barley and wheat grains were found (Amy Bogaard, *pers. comm.*). A few other shallower scoops could be seen. There was no obvious sign in the uncleaned section of a cultural layer as found in site 23B.

These initial observations appear to confirm the suggestion that Ecsegfalva site 16 belongs to the Körös culture (Ecsedy *et al.* 1982, 79).

Further discussion

Further discussion of the sequence, duration and character of the occupation of Ecsegfalva 23 is given in chapter 32.

Chapter 10

RADIOCARBON CHRONOLOGY

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Introduction

Radiocarbon dating of material from Ecsegfalva was undertaken at the Oxford Radiocarbon Accelerator Unit (ORAU). The most important of the chronometric questions asked (see also chapters 1 and 9) were the date of the occupation at Ecsegfalva 23 and its duration. Beyond this, the further aim was to compare Ecsegfalva 23 with other Körös culture sites and with other Early Neolithic manifestations in the northern Balkans (cf. Whittle *et al.* 2002).

Methodology

The radiocarbon dates for this project were determined at ORAU between 2000 to 2004 during which there were considerable developments in sample pretreatment methodology of bone and in AMS measurement precision. While not all samples were dated with the very latest in techniques we have redated some key samples where they posed specific chronological problems and where greater precision was thought useful.

The majority of samples dated for this project were bone. Two main methods were used in the chemical pre-treatment of the bone. The first of these (denoted by the laboratory code 'AG') simply involves the purification of the protein component of the bone using a series of acid and alkaline washes followed by gelatinisation and subsequent filtration of the gelatin to ensure that only soluble proteins are selected for dating. This is a well established method and similar to that used in most radiocarbon laboratories. One obvious potential problem (and indeed seen in some samples dated for this project) is that it is not a very specific method and some dates can be affected by environmental contaminants unremoved by the gelatinisation method that influence the measurements to younger or older apparent ages. The second main method we used adds an additional ultrafiltration stage (first described by Brown *et al.* 1988), in which only the larger molecular weight components are retained for dating. Fragmentary and degraded proteins and other low molecular weight contaminants are filtered out of the bone and discarded. This method is given the laboratory code 'AF'. In 2002, however, we discovered that this method can add contamination of its own, most significantly for samples whose collagen levels are low (eg. < 20–30 mg collagen). This results in dates which are too old by typically of the order of 100–200 years. A new variant of the ultrafiltration technique was then developed (Bronk Ramsey *et al.* 2004a; 2004b) which overcomes the problem and removes the derived contamination before the ultrafilters are used (we refer to this here as AF3).

In this study we consider dates measured using all three of these methods, as well as samples originally pretreated using the AF method and then repurified using cleaned ultrafiltraters (referred to here as AF1) and samples treated as AG that were similarly repurified (referred to here as AF2). In principle, methods AF1–3 should all give the same results. Dates using methods AG are potentially susceptible to environmental contamination and so any that appeared anomalous in context have been repeated either using the AF2 method, or resampled and repeated from the start of pre-treatment chemistry using the AF3 method. As mentioned above, AMS dates determined using the original AF method might be too old, especially if the collagen yields are low. Consequently all dates with low yields measured using the AF method have been repeated either using the AF1 or AF3 methods. We also repeated two dates which had high yields but whose ages were anomalous within their context. A full list of results and a detailed methodological report are given in the appendix to this chapter.

For the remainder of this section and in our conclusions we consider only the dates deemed to be acceptable. We exclude those dates prepared using older methods subsequently repeated using the latest techniques.

Results

The results for discussion are shown in *Table 10.1.* One can see from this that the dates from the different areas are very similar even when a range of pretreatment methods is applied and (as in Trench 23A) where we have dates on bone and carbonised plant material from comparable contexts. The exceptions to this are OxA-10678 (Trench 23A) and OxA-12141 (Trench 23C). In both cases, however, these are at the top of their respective sequences. The only obviously anomalous dates are OxA-12857 (Trench 23B) which is old within its context, OxA-12855 (Pit 390) which is young within its context, and OxA-9326 (Trench 23B) which is almost modern. OxA-12857 is potentially very interesting. It has been identified as a *Bos* sp. bone but at this stage it is difficult to determine whether it is a domesticated cattle bone or is *Bos primigenius.* Despite these problems, it remains a potentially very interesting piece of evidence concerned with pre-Neolithic occupation within the environs of the site. Given the fact that it is older than it ought to be given its context, it is not considered further below in models for the date and duration of the Körös culture occupation. It might, however, indicate the date of pre-Körös culture occupation at the site or in the environs, analogous to the suggestion for the early dates, before 7000 cal BC from Topole-Bač in northern Serbia (OxA-8504), and around 6500 cal BC from Maroslele-Pana in southern Hungary (OxA-X-922-30) (Whittle *et al.* 2002). This is considered further in chapter 32 below.

Calibration and analysis

To analyse the results further and consider more detailed aspects of the site chronometry, it is necessary to calibrate the dates and combine them with the contextual information gleaned from the excavation of the dated material. To perform this analysis we have used the program OxCal (v3.9, Bronk Ramsey 1995; Bronk Ramsey 2001) and the INTCAL98 calibration curve (Stuiver *et al.* 1998).

Overall chronology

The site has been divided into four areas: Trench 23A, Trench 23B (including the main occupation levels), one separate pit within Trench 23B (Pit 393), and Trench 23C.

In Trench 23A we have six dated samples. One of these (OxA-10678) lies at the top of the sequence and two of the remaining dates overlie the other three. All of this can be built into a chronological model assuming that the lowest five dates are all part of a coherent group. *Fig. 10.1*

Table 10.1. All AMS dates used in the chronometric analysis of this site. OxA-9326 was not considered further as it is clearly out of context. Pyield indicates the yield of purified material in milligrams after pre-treatment (purified collagen in the case of bone). $\delta^{13}C$ values in this chapter are reported with reference to VPDB and $\delta^{15}N$ results are reported with reference to AIR an expressed in ‰. The code 'ZR' in column one refers to the pre-treatment of charcoal remains using an acid-base-acid sequence. For bone pre-treatment codes, see text

OxA (pre-treatment code)	Species	Material	Sample ref	Trench (with boxes in B)	^{14}C age BP	Error	Pyield	CN ratio	$\delta^{13}C$	$\delta^{15}N$
Trench 23A										
11983 (AF3)	sheep/goat	bone	135/1515	A	6915	36	67.6	3.3	-19.9	10.9
11871 (ZR)	cereal grains	charred seeds	136/259	A	6930	40	41.8	20.6	-24.2	
11863 (ZR)	cereal grains	charred seeds	136/242	A	6825	45	30.8		-23.1	
9334 (ZR)	wheat (*cf.*emmer)	charred seeds	113/Flot 105	A	6855	50	8.5		-23.9	
9335 (ZR)	barley	charred seeds	113/Flot 105	A	6920	50	8.4		-23.3	
10678 (AF)	human	bone	107	A	6250	45	47.1	3.2	-19.6	9.3
Trench 23B										
12859 (AF1)	cattle	bone	397-404/10391	B (CW)	6818	44	15.6	3.3	-20.9	6.6
11982 (AF3)	sheep/goat	bone	404/10702	B (CW)	6806	39	72.7	3.3	-19.8	9.4
12855 (AF1)	sheep	bone	373/8723	B, Pit 390	6596	42	17.0	3.1	-20.0	5.4
11850 (AF)	sheep/goat	bone	369/7909	B, Pit 390	6780	50	58.6	3.3	-21.6	7.9
10501 (AF)	roe deer	bone	353/6982	B, Pit 390	6885	50	51.9	3.2	-20.1	7.1
10500 (AF)	sheep/goat	bone	347/6005	B, Pit 390	6900	60	56.9	3.2	-19.9	6.4
9333 (AG)	cattle	bone	336/4905 F3/F4/G3/G4	B, Pit 390	6860	45	33.3	3.1	-20.4	8.4
13511 (AF1)	sheep	bone	470/13793	B (N)	6785	45	26.1	3.3	-19.8	6.6
12857 (AF1)	cattle	bone	351/10818	B (CW)	7944	44		3.2	-12.3	4.9
9332 (AG)	sheep	bone	327/4783 E8	B (CW)	6810	45	26.8	3.0	-19.8	6.4
9331 (AG)	sheep	bone	316/4706 E8	B (CW)	6815	45	46.4	3.2	-19.8	6.2
12858 (AF1)	sheep/goat	bone	352/10262	B (CE)	6782	42	3.2	3.3	-20.6	5.7
11845 (AF)	cattle	bone	354/71235	B (N)	6865	40	67.8	3.3	-20.0	7.6
12854 (AF1)	sheep/goat	bone	344/6334	B (N)	6774	45	19.8	3.2	-21.0	6.7
OxA-X-2040-09 (AF2)	sheep/goat	bone	313/4230 D6	B (CW)	6780	39	4.7	3.4	-20.6	7.2
9328 (AG)	large mammal	bone	308/4157 D8	B (CW)	6815	50	7.5	3.1	-20.3	7.5
OxA-X-2040-08 (AF2)	sheep/goat	bone	307/4064 F5	B (CE)	6775	37	15.8	3.3	-19.7	6.3

Table 10.1. Continued

OxA (pre-treatment code)	Species	Material	Sample ref	Trench (with boxes in B)	^{14}C age BP	Error	Pyield	CN ratio	$\delta^{13}C$	$\delta^{15}N$
Trench 23B (cont.)										
OxA-X-2040-07 (AF2)	sheep/goat	bone	301/3178 F5	B (CE)	6787	37	11.5	3.3	-19.6	8.9
9330 (AG)	sheep/goat	bone	314/4475 F2	B (SE)	6795	50	65.0	3.1	-19.8	7.5
9325 (AG) (P10871)	Equid	bone	304-307/3814 F2	B (SE)	6690	50	30.9	3.1	-20.3	5.5
10148 (AG) (P10871)	Equid	bone	304-307/3814 F2	B (SE)	6665	50	31.2	3.1	-20.3	5.6
12140 (AF3)	sheep	bone	464/14074	B (N Ext)	6729	32	50.4	3.3	-20.7	7.0
13510 (AF1)	sheep/goat	bone	445/12845	B (N Ext)	6731	43	44.3	3.3	-21.5	8.5
Trench 23C										
12860 (AF1)	cattle	bone	528/9497	C	6826	41	10.4	3.2	-19.7	5.5
11984 (AF3)	sheep	tooth	521/9412	C	6893	36	42.0	2.9	-20.1	8.7
10505 (AF)	sheep/goat	bone	515/9365	C	6845	50	102.0	3.2	-19.7	5.9
12141 (AF3)	human	bone	545/9686	C	1335	26	17.3	3.3	-20.0	11.8
Pit 393 in Trench 23B										
11868 (AF)	cattle	bone	382/10236	B, Pit 393	6750	45	52.0	3.4	-19.5	6.8
11849 (AF)	animal	bone	374/8157	B, Pit 393	6660	40	37.8	3.3	-20.2	6.2
12655 (AF1)	sheep/goat	bone	374/8158	B, Pit 393	6830	35	23.8	3.2	-19.4	7.7
12654 (AF1)	sheep/goat	bone	359/7886	B, Pit 393	6889	36	36.5	3.0	-19.4	4.7
9326	Equid	tooth	301/3052	B (N)	187	29	62.9	3.2	-19.4	8.5

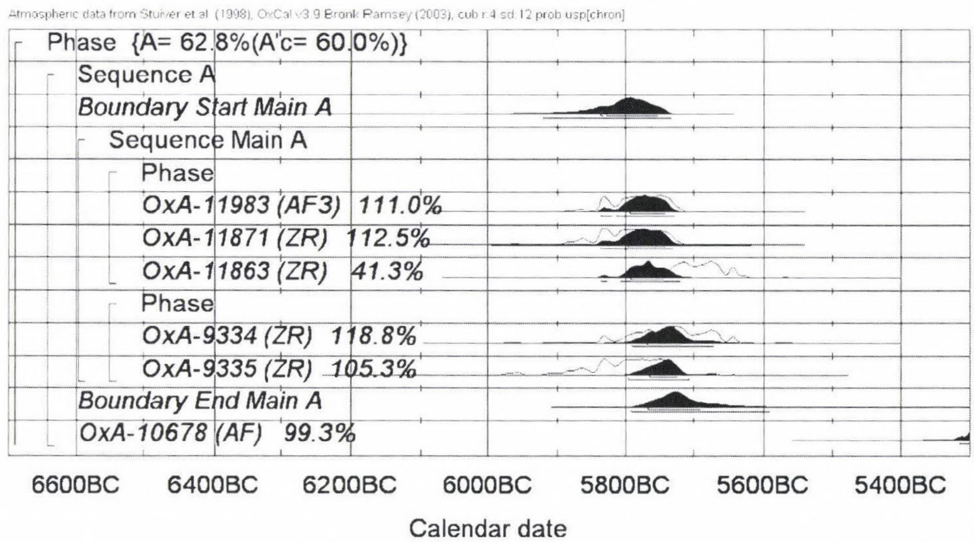

Fig. 10.1. Analysis of dates from Trench 23A. The outline distributions show the likelihoods derived only from the calibration of the radiocarbon dates. The solid distributions show the results when the stratigraphic constraints are imposed. The bars underneath the distributions show the 68.2 and 95.4% ranges from the analysis

shows that the dated samples fit a period in the early 5700s cal BC. The exact formulation of the model for this and the rest of the site is given in the appendix to this chapter.

In Trench 23B we have much more detailed contextual information and many more dated samples (see *Fig. 10.2*). The samples here are divided into four coherent groups:

1. Basal Layer
2. Pit 390
3. Earlier occupation level
4. Later occupation level

Within these groups there are additional constraints. Despite the clear separation into these different phases of activity, the period over which the main deposition seems to have formed occurred rapidly from the mid 5700s to the mid 5600s cal BC. The overall timespan for this deposition appears to be less than 150 years (see *Fig. 10.5* and *Table 10.5*).

Trench 23C has only one main level which is overlain by a human bone sample (OxA-12141) of much later date. The results for the analysis of this sequence are shown in *Fig. 10.3*. One can see from this that these samples seem to be contemporary with those from Trench 23A but probably overlap with those from Trench 23B (see *Table 10.2*).

Pit 393 is overlain by a thin spread of occupation material at the southern end of Trench 23B. The results from this pit (shown in *Fig. 10.4*) demonstrate that the samples in it span the whole range of dates from the other main levels in Trenches 23A-C and possibly extend slightly later (in the case of OxA-11849).

Fig. 10.5 shows the duration of the key events on the site. Although the span of the dated events in Trenches 23A and 23C is not very well defined because of the small number of samples, it is likely to be shorter than 150 years and may only be a few years (see also *Table 10.5*). The overall duration of activity in Trench 23B is much better defined and the whole sequence is likely to be shorter than 150 years and might be as short as a few decades, with the most probable duration being about 70–80 years, or about three generations. The filling of Pit 390 seems to be the result of a more or less synchronous event (though see chapter 9 for detailed description, and the suggestion that primary natural fill was followed by rapid dumping) and the basal layer and earlier occupation

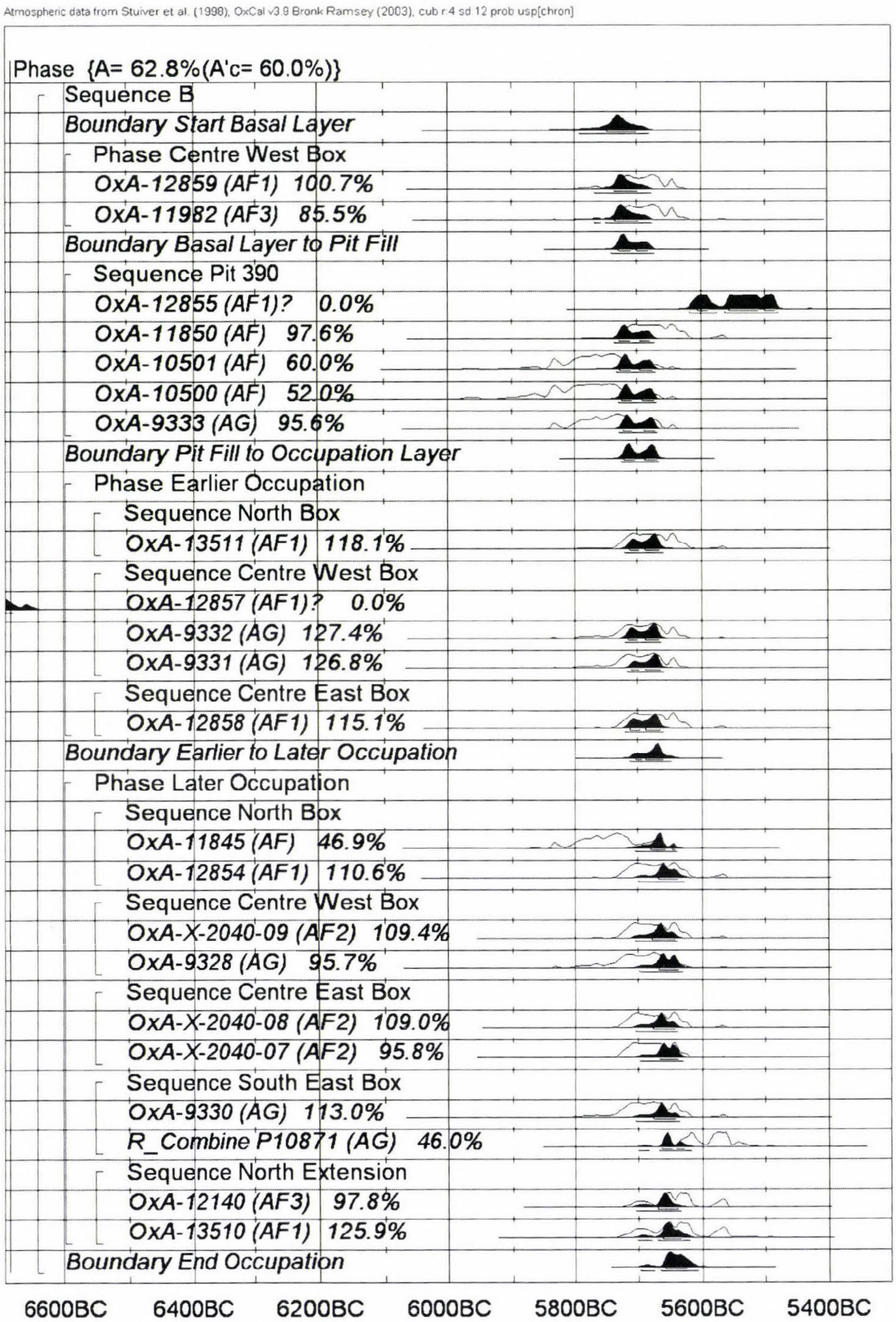

Fig. 10.2. Results of the analysis for Trench 23B; note that OxA-12857 and OxA-12855 have been plotted in their context but have not been constrained to lie within it chronologically

phases are both likely to be only a few decades long. The later occupation phase is likely to be longest, but still well short of a century. The dates from Pit 393 seem to span a longer period (here we have shown the span of the dated events as the length of the related phase is too difficult to estimate from the available data). This may relate to possible redeposition of material within this pit.

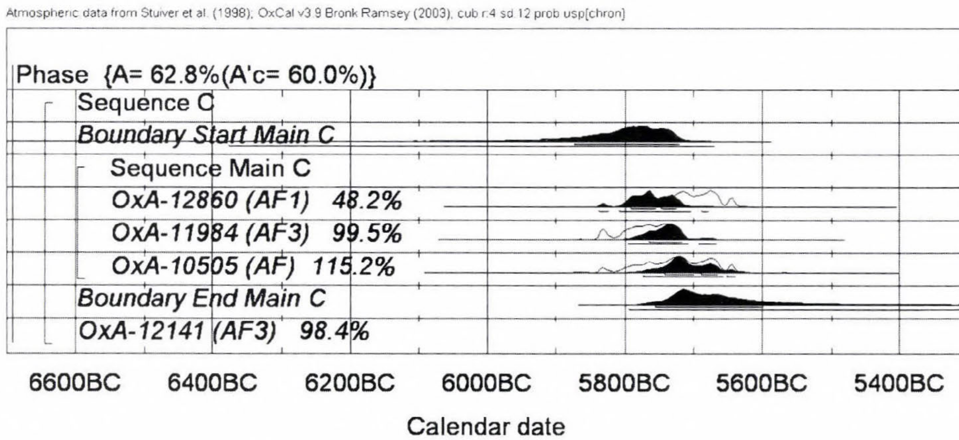

Fig. 10.3. Results of the analysis of dates from Trench 23C

Table 10.2. This shows the probability of any one dated event preceding another. For example the table shows that the 'Start Main A' has a probability of 96.7% of being before 'Start Basal Layer' and 'End Main A' has a probability of 74.8% of being before the start of the occupation layers in Trench 23B

	Start Main C	Start Main A	Start Basal Layer B	End Main A	Basal Layer to Pit Fill B	Pit Fill to Occupation Layer B	End Main C
Start Main C		52.8	89.4	91.8	96.5	98.3	100.0
Start Main A	47.2		94.7	100.0	99.6	100.0	99.2
Start Basal Layer B	10.6	5.3		59.3	100.0	100.0	86.0
End Main A	8.2	0.0	40.7		60.2	71.0	76.8
Basal Layer to Pit Fill B	3.5	0.4	0.0	39.8		100.0	75.8
Pit Fill to Occupation Layer B	1.7	0.0	0.0	29.0	0.0		67.5
End Main C	0.0	0.8	14.0	23.2	24.2	32.5	

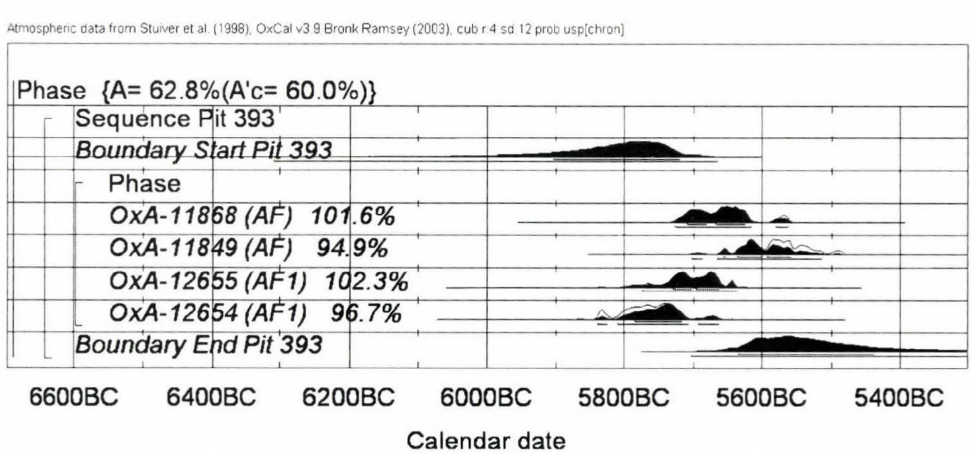

Fig. 10.4. Results from Pit 393, Trench 23B

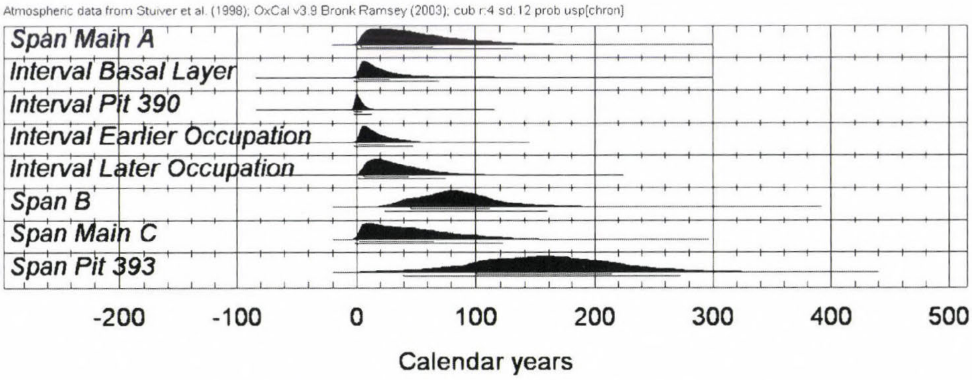

Fig. 10.5. Estimated duration of phases of activity on the site

Agreement between radiocarbon dates and model

In performing the analysis presented above the dates are constrained to be within their relevant context. We can use the individual agreement indices for the dates to see if there are any discrepancies here. It turns out that five dates have agreement indices lower than the normally acceptable level (60%). These are given in *Table 10.3*. One would expect 5% of samples to fail this test (i.e. between one and three) but five is slightly higher than expected. This is reflected in the overall agreement index (62.8%) which is just acceptable but low.

One possibility is that this reflects the range of methods used. In particular the dates obtained using the AF method might be expected to be slightly old in context even though the main outliers have been redated. To investigate this possibility we have used the results from a large series of samples dated by AF and subsequently redated using the new AF3 method with a similar range of sample sizes. Using these, and taking into account that two large collagen yield outliers had already been identified, we estimate that the higher yielding bones from this site, dated using the AF method and used in the analysis, are likely to be old by an average of 42 years. We therefore re-ran the analysis, subtracting 42 years from each of the dates with an AF pretreatment to determine how sensitive our conclusions are to this effect (Model B). With this adjustment, the overall agreement index for the model improves (89.5%) and two of the five individual samples with low agreement also become acceptable within the model *(Table 10.3)*. Similar corrections relating to results obtained using other pretreatment methods (such as AG) or to other sample types (charcoal) which might cause other offsets are not possible to apply. We cannot be sure that there is an offset in the AF dates of this precise magnitude, however our experimental data and our redating results from other samples indicate it is certainly plausible and the number of remaining outliers is as expected for a site of this size and complexity. In addition, one must not forget the possibility

Table 10.3. Agreement indices for the analysis as a whole and for possible outliers. It seems likely that the minor discrepancies present are largely due to small offsets (less than 1σ in most cases) in the remaining AF pretreated samples. The code 'ZR' in column one refers to the pre-treatment of charcoal remains using an acid-base-acid sequence

	Main analysis (Model A)	Adjusted for possible AF offset of 42 years (Model B)
OxA-11863 (ZR)	41.3	41.3
OxA-10500 (AF)	52.0	101.1
OxA-11845 (AF)	46.9	93.2
P10871 (AG)	46.0	48.8
OxA-12860 (AF1)	48.2	55.9
Overall	*62.8*	*89.5*

Table 10.4. This shows the main dates for the site in years BC from the analysis using Model A. As a comparison, Model B shows the effect of shifting all dates using the original AF method later by 42 years. Thus the start of the occupation layers in Trench 23B is dated to 5721–5669 cal BC (68% confidence) or 5724–5666 cal BC (95% confidence) taking into account both the radiocarbon dates and the stratigraphic information. This is moved later by about a decade if the AF dates are assumed to be 42 years older than they should be as can be seen in Model B

Events	Main Analysis: Model A				Model B			
	68%		95%		68%		95%	
Start Main A	5838	5752	5920	5732	5840	5752	5922	5730
End Main A	5766	5692	5792	5592	5766	5691	5794	5594
Start Basal Layer	5748	5702	5793	5680	5739	5697	5774	5678
Basal Layer to Pit Fill	5730	5683	5741	5672	5716	5684	5727	5674
Pit Fill to Occupation Layer	5721	5669	5724	5666	5694	5666	5717	5664
Earlier to Later Occupation	5703	5660	5711	5647	5681	5655	5703	5644
End Occupation	5660	5626	5698	5608	5657	5628	5695	5609
Start Main C	5873	5720	6376	5669	5896	5714	6460	5668
End Main C	5757	5600	5794	5009	5731	5560	5784	4886

of residuality. The majority of the bone selected for dating was not excavated in articulated form, increasing the possibility of outliers due to sample residuality.

In one instance (OxA-12855) the original date makes sense in context (see P12148 in *Table 10.6*) but the repeated date does not. It is not clear if this is a problem with the repeat measurement or a genuine archaeological problem. This result is not used in the modelling.

Interestingly, the horse bone (3814 F2) from Trench 23B which was dated twice using the AG method (ORAU ref P10871) could not be duplicated when redated using the AF method. This implies that the collagen preservation is poor and may therefore explain why this date appeared slightly young in context.

Summary of site chronology

The dates from this site provide a very coherent set for understanding the underlying chronology. With the exception of Trench 23B, where the activity certainly spanned a few decades, and Pit 393 at the southern end of Trench 23B, which seems to represent material from a century or so (and

Table 10.5. The duration of the main phases of Trench 23B and the spans of the dated events in Trenches 23A, 23C and Pit 393 (Trench 23B) in calendar years is shown. Here one can see that all durations are less than 159 years except for the span of dated events in Pit 393 and all phases could last less than a decade with the exception of the whole sequence in Trench 23B and the deposition in Pit 393. The use of Trench 23B seems to last between 46 and 112 years (68% confidence) or between 24 and 159 years (95% confidence). This estimate is insensitive to minor offsets in the AF dated bones as seen by the results for Model B

Intervals	Main Analysis: Model A				Model B			
	68%		95%		68%		95%	
Span Main A	4	65	0	131	4	65	0	132
Basal Layer	1	27	0	70	2	28	0	70
Pit 390	0	4	0	13	0	5	0	14
Earlier Occupation	1	24	0	48	2	21	0	41
Later Occupation	6	44	2	76	6	37	2	63
All Area B	46	112	24	159	49	104	24	142
Span Main C	2	66	0	123	4	81	0	142
Span Pit 393	101	214	39	273	132	244	94	306

Table 10.6. This shows all pre-treatments and AMS determinations made for this project. Only those with assigned OxA or OxA-X numbers are used in the chronometric analysis. The P number is a laboratory code for the sample dated, whereas the OxA number is a reference for the date obtained. For descriptions of analytical measurements, see Table 10.1 caption. For sample pre-treatment code designations, see text

P	Sample ref	Material	Species	Method	OxA	^{14}C age BP	Error	CN Ratio	$\delta^{13}C$	$\delta^{15}N$	Pyield
10871	1:23B 3814 304/307 F2	bone	Equid	AG	9325	6690	50	3.1	-20.3	5.5	30.9
				AG	10148	6665	50	3.1	-20.3	5.6	31.2
				AF2	Failed due to low yield						
10872	2:23B 3052 301	tooth	Equid	AG	9326	187	29	3.2	-19.4	8.5	62.9
				AF2	Failed due to very low yield						
10873	3:23B 3178 301 F5	bone	sheep/goat	AG		6870	50	3.1	-20.1	10.0	44.1
				AF2	OxA-X-2040-07	6787	37	3.3	-19.6	8.9	11.5
10874	4:23B 4064 307 F5	bone	sheep/goat	AG		6915	50	3.2	-20.1	6.6	61.4
				AF2	OxA-X-2040-08	6775	37	3.3	-19.7	6.3	15.8
10875	5:23B 4157 308 D8	bone	large mammal	AG	9328	6815	50	3.1	-20.3	7.5	7.5
10876	6:23B 4230 313 D6	bone	sheep/goat	AG		6950	45	3.1	-20.8	6.6	33.7
				AF2	OxA-X-2040-09	6780	39	3.4	-20.6	7.2	4.7
10877	7:23B 4475 314 F2	bone	sheep/goat	AG	9330	6795	50	3.1	-19.8	7.5	65.0
10878	8:23B 4706 316 E8	bone	sheep	AG	9331	6815	45	3.2	-19.8	6.2	46.4
10879	9:23B 4783 327 E8	bone	sheep	AG	9332	6810	45	3.0	-19.8	6.4	26.8
10880	10: 4905 336 F3/F4/G3/G4	bone	cattle	AG	9333	6860	45	3.1	-20.4	8.4	33.3
10881	11: ctx 113 Flot 105	charred seeds	wheat (cf.emmer)	ZR	9334	6855	50	16.1	-23.9	6.9	8.5
10882	12: ctx 113 Flot 105	charred seeds	barley	ZR	9335	6920	50	22.2	-23.3	4.6	8.4
12142	ECSEG99/23A/107	bone	human	AF	10678	6250	45	3.2	-19.6	9.3	47.1
12143	ECSEG00/23B/344/6334	bone	sheep/goat	AF		6840	50	3.2	-19.8	6.8	28.4
				AF1	12854	6774	45	3.2	-21.0	6.7	19.8
12144	ECSEG00/23B/347/6005	bone	sheep/goat	AF	10500	6900	60	3.2	-19.9	6.4	56.9
12145	ECSEG00/23B/353/6982	bone	roe deer	AF	10501	6885	50	3.2	-20.1	7.1	51.9
12147	ECSEG00/23B/359/7886	bone	sheep/goat	AF		7110	50	3.2	-19.4	5.4	11.8
				AF3	12654	6889	36	3.0	-19.4	4.7	36.5
12148	ECSEG00/23B/373/8723	bone	sheep/goat	AF		6770	50	3.2	-19.8	6.4	25.2
				AF1	12855	6596	42	3.1	-20.0	5.4	17.0
12149	ECSEG00/23B/374/8158	bone	sheep/goat	AF		7090	55	3.3	-20.1	7.2	10.6
				AF3	12655	6830	35	3.2	-19.4	7.7	23.8

Table 10.6. Continued

P	Sample ref	Material	Species	Method	OxA	^{14}C age BP	Error	CN Ratio	$\delta^{13}C$	$\delta^{15}N$	Pyield
12150	ECSEG00/23B/376/8952	bone	large mammal	AF	Failed due to low yield	3.2	-21.2	6.7	3.2		
12151	ECSEG00/23B/397/404	bone	sheep	AF	Failed due to low yield	3.3	-19.8	6.2	6.1		
12154	ECSEG00/23C/515/9365	bone	sheep/goat	AF	10505	6845	50	3.2	-19.7	5.9	102.0
13688	445/12845	bone	sheep/goat	AF		6835	40	3.3	-22.0	8.1	64.1
				AF1	13510	6731	43	3.3	-21.5	8.5	44.3
13689	354/71235	bone	cattle	AF	11845	6865	40	3.3	-20.0	7.6	67.8
13690	351/10818	bone	cattle	AF		7905	40	3.3	-20.9	5.9	33.5
				AF1	12857	7944	44	3.2	-12.3	4.9	
13691	352/10262	bone	sheep/goat	AF		6776	34	3.3	-20.1	6.5	13.0
				AF1	12858	6782	42	3.3	-20.6	5.7	3.2
13693	470/13793	bone	sheep	AF		6955	40	3.4	-20.2	6.0	45.6
		bone	sheep	AF1	13511	6785	45	3.3	-19.8	6.6	26.1
13696	404/10702	bone	sheep/goat	AF	11982	6806	39	3.3	-19.8	9.4	72.7
13697	397-404/10391	bone	cattle	AF		7060	40	3.3	-20.6	7.4	33.5
				AF1	12859	6818	44	3.3	-20.9	6.6	15.6
13698	374/8157	bone	animal	AF	11849	6660	40	3.3	-20.2	6.2	37.8
13699	382/10236	bone	cattle	AF	11868	6750	45	3.4	-19.5	6.8	52.0
13700	369/7909	bone	sheep/goat	AF	11850	6780	50	3.3	-21.6	7.9	58.6
13703	135/1515	bone	sheep/goat	AF3	11983	6915	36	3.3	-19.9	10.9	67.6
13705	521/9412	tooth	sheep	AF3	11984	6893	36	2.9	-20.1	8.7	42.0
13707	528/9497	bone	cattle	AF		6860	50	3.3	-20.6	5.1	21.6
				AF1	12860	6826	41	3.2	-19.7	5.5	10.4
13821	136/242	charred seeds	cereal grains	ZR	11863	6825	45		-23.1		30.8
13822	136/259	charred seeds	cereal grains	ZR	11871	6930	40	20.6	-24.2	4.5	41.8
13975	464/14074	bone	sheep	AF3	12140	6729	32	3.3	-20.7	7.0	50.4
13976	545/9686	bone	human	AF3	12141	1335	26	3.3	-20.0	11.8	17.3

therefore probably residual material), all of the other features could represent short phases (a few decades or less) and so their duration cannot be resolved by radiocarbon dating. *Table 10.4* shows the dates of the key events on the site and *Table 10.5* shows the intervals of the main phases of Trench 23B and the spans of the dated events in Trenches 23A, 23C and Pit 393 in 23B. Model B data is also shown. Here, 42 years has been subtracted from each of the AF dates using the original AF pretreatment method). There are very few significant differences between the two analyses.

Conclusions

By collecting and submitting sufficient samples from an intensively investigated portion of a single occupation site, it has proven possible to obtain accurate estimates of both the date and the duration of Early Neolithic activity at Ecsegfalva 23. Even with this methodological approach, some anomalies in certain determinations have been identified. The dating of sites of this kind, therefore, can hardly be recommended on the basis of smaller series of samples of imprecise context. This introduces an uncertainty into any wider comparisons with sites elsewhere, though possible patterns are discussed further below in chapter 32. The main results of the successful radiocarbon dating programme at Ecsegfalva 23 are that the site can be firmly assigned to the 58th–57th centuries cal BC, and that the spans of time represented by the use of differing parts of the site are all likely to have been relatively short. Even the longest, seen in Trench 23B, was probably no more than three generations in duration. The implications of both these main results are also discussed further below in chapter 32.

Appendix: Details of radiocarbon pretreatment methods and of the Bayesian model

The full set of radiocarbon measurements made on the samples from this site is shown in *Table 10.6*. The method codes are as described above and are given in further detail below. Note that only those samples with OxA and OxA-X numbers have been accepted as reliable and are used in the analysis above.

The methods used in the measurements are as detailed in Bronk Ramsey *et al.* (2000), Dee and Bronk Ramsey (2000) and Bronk Ramsey *et al.* (2004b). However, further details are given here on aspects of bone pretreatment.

Details of bone pre-treatment methodology

The five methods of bone pre-treatment used here are:

1. AG Collagen extraction and gelatinisation;
2. AF As for AG but followed by the original Ultrafiltration stage;
3. AF1 As for AF but redissolved and given a further new Ultrafiltration stage;
4. AF2 As for AG but redissolved and given a new Ultrafiltration stage;
5. AF3 As for AG but followed by a new Ultrafiltration stage.

AG method

The initial series comprised material from Trench 23B from the 1999 season. All of the bones from the site were pretreated using a modified Longin collagen technique. The bones were ground to a coarse powder and between c. 0.5–1 g was loaded into a continuous flow cell.

An automated sequence of acid, base and acid was flowed through the cell over a period of eight hours rinsing with ultra-pure (MilliQ™) water between each reagent (in some instances we performed a manual version of this procedure in a test tube).

Crude collagen was gelatinised in pH3 solution at 75°C for 20 hours and the solution filtered using a 8 μm polyethylene Eezi-filter™. The insoluble residues were discarded, the soluble gelatin was freeze-dried.

Interestingly in this site there are examples of this method giving ages that are too old and and too young, for example in the case of P10871. This is consistent with a range of environmental contaminants not sufficiently well removed by this method.

AF method

This method is additional to the AG method. Instead of freeze drying the samples at the AG stage they are given an additional ultrafiltration step. The filtered gelatin was pipetted into an ultrafilter (Vivaspin™ 15 30kD MWCO) and centrifuged at 2500–3000 rpm until 0.5–1 mL of the > 30 kD gelatin fraction remained. This was then freeze-dried prior to combustion and AMS dating.

The ultrafilter removes additional contaminants from bone where they are present, which are of low molecular weight. These may incude soil contaminants, as well as salts and low molecular weight matter which may be of a different radiocarbon age. This technique was first described by Brown *et al.* (1988) and documented in Bronk Ramsey *et al.* (2000).

Bronk Ramsey *et al.* (2004a) investigated the origin of the old contaminant that affected the bone determinations. The ultrafilters are coated with a humectant (glycerine) designed to keep the filter head moist prior to use. We investigated the possibility that the glycerine from the filters was becoming incorporated into the ultrafiltered gelatin. We extracted some of the glycerine and obtained a date from it of > 35ka BP.

We found that our existing method, which itself was more rigorous than that recommended by the manufacturer of the ultrafilters, was not sufficient to remove all traces of the humectant, despite its high solubility in water. We measured the humectant remaining after our initial cleanup and found that it was of the order required to explain the offsets we had identified. We found that for low mass collagen samples (< 20–30 mg) which were young in age (< 8000 BP) that offsets from true age could be of the order of 100–300 years too old.

AF1 method

This method comprised a redissolution of the gelatin from the AF pre-treatment and subjecting it to a further ultrafiltration but this time conducted with ultrafilters pre-cleaned using the new method described in Bronk Ramsey *et al.* (2004a). This method has been tested on bone gelatin previously ultrafiltered with the less rigorous cleanup and it was found to remove at least 90% of the glycerin contamination present in that gelatin. The dates are corrected, therefore, on the basis of the offset effected by the remaining 10% of contamination that may remain.

AF2 method

This method involves redissolving the gelatin product derived from the AG pre-treatment and subjecting it to the new ultrafiltration method described above. In principle, the method should be analogous to AF3 (see below) but this has not been extensively tested on known-age material. Consequently, dates prepared by this method are give the OxA-X designation, indicating an experimental technique.

AF3 method

This method is as described in Bronk Ramsey *et al.* (2004a). Essentially it involves a first stage which is the same as the AG method but before freeze drying the collagen is ultrafiltered using filters especially pre-cleaned and tested to ensure that all measurable humectant is extracted prior to use.

Discussion

The discarded dates pretreated using the AG method are assumed to have been affected by environmental contamination not removed by this standard, but not very selective method. The dates not used and pretreated with the AF method are normally those of lower yield (with the exception of P13688 and P13693 which are higher in yield than some of those accepted but were clearly anomalous in context). Many of the repeated dates are in agreement with the original ones but the date using the newest method have always been used in the analysis.

Some of the dates accepted might be viewed as less reliable than others – in particular those pretreated using the older AG and AF methods (see the discussion of outliers in the main text above). The individual samples that might be questioned are those for sample P10871 (see above) and OxA-9326 (which is very young anyway and so not relevant in this context), which seemed to have degraded collagen. OxA-12858 is also questionable in that its collagen yield is lower than acceptable for this method, however, the date is in very good agreement with others in its context.

Bayesian model

The calibration and analysis were performed using v3.9 of OxCal with the default settings (resolution 4 years, cubic interpolation, uniform prior for overall span on) except that no rounding was applied. The model is fully specified by the input script which is given here.

```
Phase
{
 Sequence "A"
 {
  Boundary "Start Main A";
  Sequence "Main A"
  {
   Phase
   {
    R_Date "OxA-11983 (AF3)" 6915 36;
    R_Date "OxA-11871 (ZR)" 6930 40;
    R_Date "OxA-11863 (ZR)" 6825 45;
   };
   Phase
   {
    R_Date "OxA-9334 (ZR)" 6855 50;
    R_Date "OxA-9335 (ZR)" 6920 50;
   };
   Span "Main A";
  };
  Boundary "End Main A";
  R_Date "OxA-10678 (AF)" 6250 45;
```

```
};
Axis -6700 -5300;
Page;
Sequence "B"
{
 Boundary "Start Basal Layer";
 Phase "Centre West Box"
 {
  Interval "Basal Layer";
  R_Date "OxA-12859 (AF1)" 6818 44;
  R_Date "OxA-11982 (AF3)" 6806 39;
 };
 Boundary "Basal Layer to Pit Fill";
 Sequence "Pit 390"
 {
  Interval "Pit 390";
  R_Date "OxA-12855 (AF1)" 6596 42?
  R_Date "OxA-11850 (AF)" 6780 50;
  R_Date "OxA-10501 (AF)" 6885 50;
  R_Date "OxA-10500 (AF)" 6900 60;
  R_Date "OxA-9333 (AG)" 6860 45;
 };
 Boundary "Pit Fill to Occupation
Layer";
 Phase "Earlier Occupation"
 {
  Interval "Earlier Occupation";
  Sequence "North Box"
  {
   R_Date "OxA-13511 (AF1)" 6785 45;
  };
  Sequence "Centre West Box"
  {
   R_Date "OxA-12857 (AF1)" 7944 44?
   R_Date "OxA-9332 (AG)" 6810 45;
   R_Date "OxA-9331 (AG)" 6815 45;
  };
  Sequence "Centre East Box"
  {
   R_Date "OxA-12858 (AF1)" 6782 42;
  };
 };
 Boundary "Earlier to Later Occupa-
tion";
 Phase "Later Occupation"
 {
  Interval "Later Occupation";
  Sequence "North Box"
  {
   R_Date "OxA-11845 (AF)" 6865 40;
   R_Date "OxA-12854 (AF1)" 6774 45;
  };
  Sequence "Centre West Box"
  {
   R_Date "OxA-X-2040-09 (AF2)" 6780 39;
   R_Date "OxA-9328 (AG)" 6815 50;
  };
  Sequence "Centre East Box"
  {
   R_Date "OxA-X-2040-08 (AF2)" 6775 37;
   R_Date "OxA-X-2040-07 (AF2)" 6787 37;
  };
  Sequence "South East Box"
  {
   R_Date "OxA-9330 (AG)" 6795 50;
   R_Combine "P10871 (AG)"
   {
    R_Date "OxA-9325 (AG)" 6690 50;
    R_Date "OxA-10148 (AG)" 6665 50;
   };
  };
  Sequence "North Extension"
  {
   R_Date "OxA-12140 (AF3)" 6729 32;
   R_Date "OxA-13510 (AF1)" 6731 43;
  };
 };
 Boundary "End Occupation";
 Span "B";
};
Axis -6700 -5300;
Page;
Sequence "C"
{
 Boundary "Start Main C";
 Sequence "Main C"
 {
  R_Date "OxA-12860 (AF1)" 6826 41;
  R_Date "OxA-11984 (AF3)" 6893 36;
  R_Date "OxA-10505 (AF)" 6845 50;
  Span "Main C";
 };
 Boundary "End Main C";
 R_Date "OxA-12141 (AF3)" 1335 26;
};
Axis -6700 -5300;
Page;
Sequence "Pit 393"
{
 Boundary "Start Pit 393";
 Phase
 {
  R_Date "OxA-11868 (AF)" 6750 45;
  R_Date "OxA-11849 (AF)" 6660 40;
  R_Date "OxA-12655 (AF1)" 6830 35;
  R_Date "OxA-12654 (AF1)" 6889 36;
  Span "Pit 393";
 };
 Boundary "End Pit 393";
};
```

```
Axis -6700 -5300;
Order
{
 XReference "Start Main A";
 XReference "End Main A";
 XReference "Start Main C";
 XReference "End Main C";
  XReference "Start Basal Layer";
  XReference "Basal Layer to Pit
Fill";
  XReference "Pit Fill to Occupation
Layer";
 };
};
```

Chapter 11

SOILS AND DEPOSITS: MICROMORPHOLOGY

Richard Macphail

Site formation processes at Ecsegfalva reflect the natural environment (alluvial geology, semi-warm steppe soil/chernozem formation), and the intensity and duration of human occupation. Artefacts and ecofacts (bones, charred grains, and so on) occur within the soils and deposits at the site, but these also carry their own microscopic (this chapter), and chemical and magnetic information (Crowther, chapter 12); and these can be interpreted to aid the reconstruction of the site. It is well known that micromorphology can be used to identify the pedogenic history of a soil, but microfeatures and inclusions can also be studied to identify specific human activities. For example, soil micromorphology revealed that much of the occupation deposit is formed of ash and other burned waste, a potential source of phosphate and enhanced magnetic susceptibility. Contextual and locational relationships between chemical and micromorphological data are therefore an important component of this investigation. Whilst micromorphology can detail various features that suggest episodic use of the site, and areas of different use, chemistry can give measures of this in terms of phosphate and magnetic susceptibility. Overall concentrations of phosphate, above background levels, may even provide a quantification of human impact on the environment.

Introduction to soil micromorphology

The soils and archaeological sediments at Ecsegfalva have their origins in the local deeply weathered loess-enriched alluvium that developed on the Pleistocene levée of Kiri-tó (see Sümegi and Molnár, chapter 5). This weathering produced natural clay-rich alluvial gley soils/gleysols (Calcaric Chernozems) that were probably influenced by the activities of Early Neolithic people, whilst occupation itself created an overlying ash- and burned daub-rich anthropogenic stratigraphy and pit fills. In order to study these archaeological soils and deposits, undisturbed samples from the 1999, 2000 and 2001 excavation seasons were investigated through soil micromorphology and microprobe analysis *(Table 11.1)*. Sampling for soil micromorphology was closely correlated with that for chemistry (chapter 12); assessments of the soil micromorphology were carried out during 1999–2001, with chemical samples also being assessed from the 1999 season (by Johan Linderholm, University of Umeå, Sweden), which led to the present major chemical study by John Crowther (chapter 12).

Samples and methods

Undisturbed monolith samples *(Table 11.1)* were impregnated with a crystic resin mixture and blocks were sawn up to make 75 × 50 mm-size thin sections at the Institute of Archaeology, UCL for manufacture by Spectrum Petrographics, Oregon, USA (Murphy 1986). 55 thin sections

Table 11.1. Ecsegfalva: soil micromorphology: sample list

Area	Year	Sample	Thin section	Rel. depth	Context	Comment
23A	1999	1240	M1240 (Ec3)	20–95 mm	(Under burial)	
			M1240 (Ec4)	185–260 mm	ditto	
			M1240 (Ec5)	280–355 mm	ditto	
23A	2000	1241	M1241 (Ec6)	165–240 mm	103, 104, 109, 111 subsoil/natural	
23A	2001	1412	M1412a1	40–110 mm		
			M1412a2	140–220 mm		
			M1412b1	230–300 mm		
			M1412b2	320–390 mm		
			M1412c	470–540 mm		
23B	1999	5769	M5769a (Ec1)	40–110 mm	301–335	
			M5769b (Ec2)	110–190 mm	301–335	
23B	1999	5771			Pit 390 SE Box	Pit 390
23B	1999		M5771a (Ec7)	230–300 mm	341–345	Pit 390
			M5771b (Ec8)	375–450 mm	347	Pit 390
			M5771c (Ec9)	515–590 mm	348	Pit 390
23B	2000	10156	M10156	0–75 mm	384 pale lens	Probe
		10779	M10779a	0–70 mm	350	Pit 390
			M10779b	70–145 mm	350–357	Pit 390
			M10779c	145–200 mm	369	Probe, Pit 390
		10778	M10778a	200–270 mm	373 upper	Pit 390
			M10778b	270–340 mm	373 upper	Pit 390
		10777	M10777a1	360–435 mm	373 lower	Pit 390
			M10777a2	435–510 mm	373 lower	Pit 390
			M10777b1	510–585 mm	378	Pit 390
			M10777b2	585–660 mm	385–384	Pit 390
		10780	M10780	daub	305	
		10781	M10781	0–7.5 mm	Area F/11	
		10782	M10782	0–75 mm	Area D/10	
		10783	M10783	0–75 mm	402–359	

(eight in 1999; 21 in 2000; 26 in 2001) were studied using the polarising microscope (x1–x200), using plane polarised light (PPL), crossed polarised light (XPL), and oblique incident light (OIL). Thin sections were also investigated employing fluorescence microscopy, with blue light (BL). Standard soil micromorphological descriptions were carried out using authorities on soil and sediment micromorphology (Bullock *et al.* 1985; Stoops 1996; 2003). The archaeological soil micromorphology database was also utilised (Courty *et al.* 1989; Courty 2001; Goldberg *et al.* in preparation). A Jeol JXA8600 EPMA was used at the Institute of Archaeology, UCL, to carry

Table 11.1. Continued

Area	Year	Sample	Thin section	Rel. depth	Context	Comment
		10784	10784a	7–14.5 mm	327–342	
			10784b	145–210 mm	342–351	
			10784c	210–270 mm	351–397	
		10785	M10785	0–75 mm	420 and 348	
?		11884	M11884	Daub	?	
23B	2001	14323	M14323	Daub/plaster	464, M15 left	
		14324	M14324	Daub/plaster	464, M15 right	Probe
		14325	M14325	Daub/plaster	464, B14	
		1	1	Exp. Daub		
23B		2	2	Exp. Daub		
		3	3	Exp. Daub		
		14522	M14522a	40–115 mm	482/483	
			M14522b1	150–250 mm	484	
			M14522b2	250–325mm	485	
		14590	M14590	0–75mm	469, sq L10	W. Ext
		14631	M14631	0–75mm	422/445/464	Bracketing topsoil/top occupation; N. Ext
	2001	14647	M14647	0–75mm	464	N.Ext. finds rich sq. C15
		14758	M14758	0–75mm	452/600	W. ext in general 469
		14779	M14779	0–75mm	486–493	W. Ext. under daub wall 438 (in general 469)
23C	1999	9381	M9381	0–75 mm	512–514	
23C	2000	col 9641	M9641a1	0–75 mm	South section fill of shallow pit; basal part complemented by 9644	
			M9461a2	75–150 mm		
			M9461b1	180–255 mm		
			M9461b2	280–355 mm		
			M9461c ??	360–400 mm		
		9644	M9644	(0–75 mm)	Basal part of section/shallow pit	
		col 9674	M9674		542/543	

out microprobe analyses of soil microfabrics, features and included materials in three samples (M10156, M10779c and 'plaster-coated' daub sample M14324). Counts of inclusions and features were recorded systematically on 11 thin sections *(Table 11.2)* (Macphail and Cruise 2001), but unfortunately, because of time constraints, this level of recording could not be sustained. Nevertheless, all soil microfabric and soil microfacies types (SMTs), and included materials have been described and recorded semi-quantitatively *(Table 11.3)*. Thin sections are listed by site (23A, 23B, 23C) and by number.

Table 11.2. Ecsegfalva soil micromorphology

Sample	Thin section	Rel. depth	Area	Context	Microfabric Type (MFT)	Included Fe/Mn nodules	Massive	Prisms	Subangular blocky	channels	chambers	Planes	Burrows	Vughs and vesicles	Root traces
			23A												
	M1412a1	40–110 mm			1b1	*		fffff					f	ff	a*
	M1412a2	140–220 mm			1a(1b)	*		fffff					f	*	a*
	M1412b1	230–300 mm			1b			fffff					ff	*	
	M1412b2	320–390 mm			1b and 2	*		fffff					ffff		
	M1412c	470–540 mm			1	*		ffff	ff				fff	f	
14522	M14522a	(0–150 mm)	23B	482/483	3	f		ff	fff	f	f	fff	f	*	a*
	M14522b1	150–250 mm	23B	484	1a(2)	f		fffff		ff	ff	fff	f		a*
	M14522b2	250–325mm	23B	485	1a(2)	ff		fffff		ff	ff	ffff	*		a*
14647	M14647	0–75 mm	23B	464	1b(2)/3	*		fff	fff	ff	f	ff	ff		a*
14590	M14590	0–75 mm	23B	469	1c	*	ffff		ff	ff	f	fff	f		a*
14758	M14758	0–75 mm	23B	452/600	1c(2)/3	*		fff	fff	ff	f	fff	ff		a*
14631	M14631	0–75 mm	23B	422/445/464											
14779	M14779	0–75 mm	23B	486–493											

NB: *: very few (0–5%); f: few (5–15%); ff: frequent (15–30%); fff: common (30–50%); ffff: dominant (50–70%); a: rare < 2% (a*:1%; a-1: single occurrence; a-2: two occurrences); aa:occasional 2–5%; aaa: many (5–10%); aaaa: abundant (10–20%); aaaaa: very abundant (> 20%)

Table 11.2. Continued

Sample	Thin section	Rel. depth	Area	Context	Burned daub (clay)	Bone	Human? Coprolite	Allocthonous diatom soil	Burned daub (dung/micaceous fine sand)	Charcoal	Phytoliths	Coarse Poaceae inclusion	Micritic pedofeatures	Fe/Mn impregnation
			23A											
	M1412a1	40–110 mm			a	a*	a*			aa	aa			aaa
	M1412a2	140–220 mm			aa	a*	a*			a	a		a*	a
	M1412b1	230–300 mm			aaa	a*	a*			aa	aa	a*	aaa	
	M1412b2	320–390 mm			aaa	a-1	a*			aa	aa		aa	aaa
	M1412c	470–540 mm			aaa		a*			aa	aa	a*	aaaaa	aa
14522	M14522a	(0–150 mm)	23B	482/483	aa	a			aaa	aaa	a		a*	aa
	M14522b1	150–250 mm	23B	484	aa	a-2			a	aa	a		aa	aaaa
	M14522b2	250–325mm	23B	485	a*	a-1				aa	a*		aa	aaaa
14647	M14647	0–75 mm	23B	464	aaa	a	a-2	a-1	a*	a*	a/aa	a-1	aa?	a
14590	M14590	0–75 mm	23B	469	a	a*	a-2	a-2		a*	a	a-1 (4/2.5)	aa	aa
14758	M14758	0–75 mm	23B	452/600	a	a*				a	a/aa		a	aaa
14631	M14631	0–75 mm	23B	422/445/464										
14779	M14779	0–75 mm	23B	486–493										

NB: *: very few (0–5%); f: few (5–15%); ff: frequent (15–30%); fff: common (30–50%); ffff: dominant (50–70%); a: rare < 2% (a*:1%; a-1: single occurrence; a-2: two occurrences); aa:occasional 2–5%; aaa: many (5–10%); aaaa: abundant (10–20%); aaaaa: very abundant (> 20%)

Table 11.2. Continued

Sample	Thin section	Rel. depth	Area	Context	(Fe?) depleted fabric	Dusty clay coatings	Intercalations	Limpid to dusty clay coatings	Welded biological fabric	>500 µm organo-mineral excrements	<500 organo-mineral excrements
			23A								
	M1412a1	40–110 mm				aa	aa		aaaa	aaa	
	M1412a2	140–220 mm					a		aaaa	aaa	
	M1412b1	230–300 mm				a*	a*		aaaa	aaaaa	a
	M1412b2	320–390 mm				a			a	aaaaa	aa
	M1412c	470–540 mm				aa			a	aaa	aaa
14522	M14522a	(0–150 mm)	23B	482/483		a			aaa	aa	a*
	M14522b1	150–250 mm	23B	484	aa				aaaaa	aaa	a*
	M14522b2	250–325mm	23B	485	aa				aaaaa	aa	
14647	M14647	0–75 mm	23B	464					aaa	a	a
14590	M14590	0–75 mm	23B	469					aaaa	a	a
14758	M14758	0–75 mm	23B	452/600		a*		a	aaa	a	aa
14631	M14631	0–75 mm	23B	422/445/464							
14779	M14779	0–75 mm	23B	486–493							

NB: *: very few (0–5%); f: few (5–15%); ff: frequent (15–30%); fff: common (30–50%); ffff: dominant (50–70%); a: rare < 2% (a*:1%; a-1: single occurrence; a-2: two occurrences); aa:occasional 2–5%; aaa: many (5–10%); aaaa: abundant (10–20%); aaaaa: very abundant (> 20%)

Table 11.3. Ecsegfalva: Microfacies types (soil microfabric types and associated data)

(Very few: 0–5%; few: 5–15%; frequent: 15–30%; common: 30–50%; dominant: 50–70%; trace: < 1%; rare: 1–2%; occasional: 2–5%; many: 5–10%; abundant: 10–20%; very abundant: > 20%)

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
TRENCH 23A				
Microfacies 1a and 1b / Soil Microfabric Type 1a and 1b	Deposits under AVK burial (108, 110, 113)	**M1240a** (Ec3)	20–95 mm SM: As 1240b, dominantly SMT 1a with frequent SMT 1b; many burned daub, occasional burned soil; rare traces of leached bone (scat/coprolite); rare clay coatings; many secondary calcium carbonate impregnation; weak Fe/Mn hypocoatings on prismatic structures; abundant thin to coarse burrowing.	Prismatic with root channels and burrows; with integrated coarse burned soil fragments, secondary carbonate. *Soil dump, here dominated by subsoil material, with few anthropogenic inclusions; showing marked root action and burrowing.*
Microfacies 1a and 1b / Soil Microfabric Type 1a and 1b	Deposits under AVK burial (108, 110, 113)	**M1240b** (Ec4)	185–260 mm SM: As 1240c, but with dominant amounts of SMT 1a and frequent SMT 1b, and only occasional burned daub, burned soil and rare charcoal, examples of burned bone; occasional micritic impregnation and example of weak concentric Fe/Mn nodule formation.	Prismatic, secondary carbonate and clay coatings, with small amounts of various types of burned soil (e.g. hearth) and daub (structure); fine charcoal throughout. *Soil dump, here dominated by subsoil material, with few anthropogenic inclusions; later affected by clay inwash.*
Microfacies 1b (with) 1a / Soil Microfabric Type 1b (with 1a)	Deposits under AVK burial (108, 110, 113)	**M1240c** (Ec5)	280–355 mm SM: very heterogeneous with dominant SMT1b and frequent SMT1a; *Coarse mineral*: as SMT 1a and 1b, and includes rare Fe/Mn nodules; *Coarse organic and anthropogenic inclusions*: abundant burned daub, rare charcoal, burned soil; with rare examples of bone, likely human coprolite (including inclusion of possible cereal material), ash, with occasional patches of phytolith-rich ash residues, some Poaceae-like, some possibly relict herbivore dung; *Fine fabric*: as SMT1b; *Pedofeatures*: rare to occasional thin (50–150 μm) but dusty clay void coatings, commonly coating fragmented peds; many micritic impregnation, rare hypocoatings of 'root' channels; micritisation also taking place, e.g., of human coprolite; many diffuse impregnative Fe/Mn nodules; very abundant, up to very broad (6 mm) burrows.	Prismatic, partially gleyed and highly heterogeneous with mixed inclusions – burned soil, burned daub, fine charcoal, ashes, human coprolites, phytoliths, some as articulated sheets – cereals?; possible ashes of wood, animal dung?? Later phases of calcium carbonate impregnation, including micritisation, with last phase(s) of clay inwash. *Very mixed dump of subsoil, occupation soil and anthropogenic inclusions; gleyed with secondary carbonate formation; later dumping has led to clay inwash.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 1a / Soil Microfabric Type 1a	Base of deposits and top of subsoil in SW corner of trench (103, 104, 109, 111)	M1241	165–240 mm SM: mainly homogeneous: *Structure*: moderately well developed prismatic, fine channel and moderately burrowed microstructure; 25% voids (10% intra-ped voids), dominant well accommodated planar medium (1–2 mm) voids; frequent medium channels (rooted); *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 85:15, *Coarse*: very dominant silt-size sub-angular quartz and mica laths, with few sand size calcite and gravel size micritic carbonate; few shell (max. 9 mm long); 2 examples of totally spherical 1 mm size Fe/Mn pisolitic nodules; *Coarse organic and anthropogenic inclusions*: rare very fine (max. 2 mm) very pale, 'leached' bone/scat?; trace amounts of charcoal; *Fine fabric*: very dominant SMT 1a), finely speckled, pale grey (PPL), high interference colours (very open porphyric [coarse silt], parallel striate- speckled and crystallitic b-fabric, XPL), pale grey (OIL); trace amounts of organic matter and fine charcoal; *Pedofeatures*: rare 50 µm thick very finely dusty, often very pale, clay void coatings (vughs and planar voids); very abundant micritic calcite impregnation of soil matrix; occasional weakly formed Fe hypocoatings on prismatic planar voids, and coarse patches of soil; occasional thin (< 1 mm) burrows. BD: 1241f	Prismatic soil of fine silty alluvium, with shell (alluvial freshwater molluscs?), strongly diminishing charcoal and humic staining down-profile, with rare leached bone/scat; secondary carbonate formation. *Example of moderately calcareous and gleyed subsoil (with alkaline pH), formed out of fine alluvium (molluscs; scat); very little influenced by overlying quarry fills, apart from trace amounts of fine dusty clay inwash.*
Microfacies 1b / Soil Microfabric Type 1b	Fill of pit or scoop 136	M1412a1	40–110 mm SM: as SMT1b – M1412a2, but with frequent vesicles (and associated intercalations and dusty clay coatings) as well as channels; rare Fe/Mn pisolitic nodules (max. 2.5 mm); many amorphous and charred organic matter, with many diffuse Fe/Mn impregnations.	*Dumps of well homogenised soil and occupation deposits; moderately strongly affected by localised slaking and structural collapse (causing 'clay' to wash down profile).*
Microfacies 1b (with 1a) / Soil Microfabric Type 1b (with 1a)	Fill of pit or scoop 136	**M1412a2**	140–220 mm SM: as SMT1a, with occasional 5 mm wide burrow fill of SMT1b; very few pisolitic Fe/Mn nodules; rare examples of coarse sand size likely human coprolitic material with plant tissue inclusions, and occasional charred material (cess); and rare examples of bone and *in situ* roots; rare traces of dusty clay coatings occasional vesicles with associated very dusty coatings; rare micritic impregnation, with occasional diffuse Fe/Mn impregnation.	Strongly biologically worked dump of lower subsoil, with inclusions of daub and 'toilet' waste (cess)?; occasional vesicles and textural features. *Dumps of lower subsoil material with traces of ' toilet' waste (cess); wet conditions and localised slaking/removal of carbonates.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 1b / Soil Microfabric Type 1b	Fill of pit or scoop 136	**M1412b1**	230–300 mm SM: as SMT1b with medium size root channels; with 2 mm size possible ashed herbivore coprolite; 3 × 0.5–2 mm size human coprolitic material/cess?, a single 10 × 16 mm size pottery fragment; abundant gravel-size reddish clay daub; rare examples of large articulated phytoliths and bone; *Fine fabric*: as SMT1b, with many fine charred material; *Pedofeatures*: rare examples of thin (50–100 µm) but sometimes laminated (10 µm) dusty clay void coatings, with fine charcoal? (generally post-dating biological mixing and in places post-dating calcitic hypocoatings); many micritic impregnation and hypocoatings; very abundant, up to very broad (6 mm) burrows, with soil as total excremental fabric; rare < 0.5 mm size organo-mineral excrements.	As below with greater inclusion of fine charred organic matter, likely human coprolitic material and bone, as well as rare examples of possible ashed herbivore coprolite. *Dumped material (including traces of food and 'toilet' waste, and dung) strongly mixed and homogenised by biological activity; later affected by carbonate and later inwash of 'clay'.*
Microfacies 1b / Soil Microfabric Type 1b	Fill of pit or scoop 136	**M1412b2**	320–390 mm SM: as SMT 1a; heterogeneous with dominant SMT1b and frequent SMT1a ; *Coarse* mineral: includes occasional gravel size micritic carbonate and rare Fe/Mn nodules; *Coarse organic and anthropogenic inclusions*: abundant burned daub, rare charcoal; with rare examples of bone, likely human coprolite, ash, with occasional patches of phytolith-rich ash residues; SMT1b as SMT1a, but with rare fine amorphous and charred organic matter; SMT1b, speckled and dotted, pale reddish grey (PPL), patches of medium and high interference colours (open porphyric, speckled and crystallitic b-fabric, XPL), grey and orange with black specks (OIL); occasional patches of charred organic matter, and rare traces of amorphous organic matter; rare phytoliths; *Pedofeatures*: rare thin (50 µm; max. 150 µm) but sometimes laminated (10 µm) dusty clay void coatings, with fine charcoal? (generally post-dating biological mixing); occasional micritic impregnation; many diffuse impregnative Fe/Mn nodules; very abundant, up to very broad (6 mm) burrows sometimes with 'U' shape infills (SMT2).	SMT1b, deep subsoil and biologically homogenised mixtures of subsoil and anthropogenic material (ash, fine charcoal, reddish fine daub, phytoliths – SMT2); succeeded by dusty clay (fine charcoal-rich) void coatings *Dumped material strongly mixed and homogenised by biological activity; then renewed dumping, and 'clay' inwash.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 1a with 2 / Soil Microfabric Type 1a with 1c	Fill of pit or scoop 136	M1412c	470–540 mm SM: heterogeneous: *Structure*: moderately well developed prismatic, fine channel and moderately burrowed microstructure; 25% voids (10% intra-ped voids), dominant well accommodated planar medium (1–2 mm) voids; frequent medium channels (rooted), with frequent complex packing voids (in loose burrow fill); frequent fine (200–400 µm) channels; *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 85:15, *Coarse*: very dominant silt-size sub-angular quartz and mica laths, with few sand size calcite and gravel size micritic carbonate; rare shell; example of totally spherical 1 mm size Fe/Mn pisolitic nodule; *Coarse organic and anthropogenic inclusions*: very abundant reddish and dark brownish burned daub, sub-rounded up to 10 mm; many finely fragmented to coarse (3 mm) charcoal; rare yellow, amorphous coprolitic (Ca/P) material (max. 1 mm) material; rare sand size patches of ash, fine charcoal and phytoliths, with rare clumps of calcite ash (Poaceae ash)(SMT 1c); rare instances of melted silica (phytoliths) and micritic ash; *Fine fabric*: very dominant SMT1a), finely speckled, pale grey (PPL), high interference colours (very open porphyric [coarse silt], parallel striate- speckled and crystallitic b-fabric, XPL), pale grey (OIL); trace amounts of organic matter and fine charcoal; few SMT2, grey with black inclusions and brown staining (PPL), isotropic, with few patches of very high interference colours (close porphyric, isotic and crystallitic b-fabric, XPL), grey with black inclusions (OIL); many charred amorphous and plant fragments, with very abundant siliceous phytolith material, some articulated; *Pedofeatures*: occasional 50 µm thick finely dusty (charcoal?) clay void coatings; very abundant micritic calcite impregnation of soil matrix, and inclusions such as coprolites; occasional very fine, diffuse Fe/Mn impregnative nodules; very abundant broad (1–5 mm) burrowing, sometimes with 'U' shape infills; many very broad (10 mm) burrows with finely fragmented and loose infills (insects?).	Burrowed mixed calcitic and weakly Fe/Mn mottled subsoil (SMT1a) and anthropogenic materials; with included ashed Poaceae material (SMT2), coprolites and much burned daub; all affected by dusty clay coatings. *Base of pit/scoop fill, with weakly calcareous and gleyed subsoil/parent material partially mixed with anthropogenic material through likely earthworm and insect burrowing.*
TRENCH 23B				
Microfacies 4a / Soil Microfabric Type 4a	Main east section 1999, CE Box, square G6, from top of 301 down to 335. This is upper and main occupation deposit in this area.	**M5769a** (Ec1)	40–110 mm SM: Mainly homogeneous with subangular blocky structures; *Mineral*: as SMT 2c; *Coarse organic and anthropogenic inclusions*: many gravel-size daub (SMT D1 and D2); occasional sand-size shell, coprolite, bone and charcoal; *Fine fabric*: very dominant SMT 4a), speckled and dotted, dark yellowish brown (PPL), low to moderately low interference colours (close porphyric, speckled with crystallitic b-fabric, XPL), greyish brown with whitish patches and black specks (OIL); abundant fine organic matter and charred fine organic matter; rare traces of phytoliths and ash; *Pedofeatures*: very abundant fabric (burrow) mixing – total excremental fabric.	Highly biologically homogenised, weathered humic soil (fragmented into subangular blocks), which includes likely coprolitic bone, coprolitic nodule?, burned daub, and mixed anthropogenic soils. Probably deposit was thicker before weathering. *Upper occupation deposits that have been homogenised by biological activity from recent surface soils; the occupation deposit has undergone probable partial decalcification of once-ash-rich material.*

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 4b and 4c / Soil Microfabric Type 4b and 4c	**As above**	**M5769b** (Ec2)	110–190 mm SM: As SMT 4a (with many burned daub, examples of probable human coprolite containing phytoliths, and vesicular [burned] soil, modern roots); but with common SMT 4b), cloudy and speckled grey (PPL), high interference colours (open porphyric, crystallitic b-fabric, XPL), grey with few black specks (OIL); traces of fine amorphous and charred organic matter with rare phytoliths and many ash crystals; and frequent (in burrow) SMT 4c), grainy and colourless, with fine vesicles (PPL), isotic(?) except for fine patches of high interference colours (open porphyric, undifferentiated b-fabric with crystallitic b-fabric), pale grey (OIL); non-humic with possible very abundant siliceous relict material/phytoliths, and rare ash crystals; *Pedofeatures*: very abundant fabric (burrow) mixing – total excremental fabric.	As above, with burned materials, burned daub containing relic plant fragments, shell, burned bone, strongly weathered (?) cereal ash (?: SMT 4c) and little weathered ash (SMT 4b). *Partially weathered (decalcified) occupation deposit rich in ashed remains, including possible cereal(?) ash.*
Microfacies 5 / Soil Microfabric Type 5	**Upper fill (341–345) of pit 390**	**M5771a** (Ec7)	230–300 mm SM: moderately heterogeneous; *Structure*: moderately well developed medium prismatic, with channel microstructure; 25% voids (10–15% intra-ped voids), dominant well accommodated planar medium (1–4 mm) voids; frequent medium channels (rooted); *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 25:75, *Coarse*: very dominant mica, with frequent to common silt-size quartz (with coarse anthropogenic inclusions); *Coarse organic and anthropogenic inclusions*: occasional to abundant burned daub (SMT D1 and D2), rare to occasional shell, rare but ubiquitous fine (extant) roots; trace amounts of fine to coarse burned bone and bone; trace to rare amounts of burned coprolite (human and dog?); abundant inclusions of rounded to subrounded strongly to weakly burned soil clasts that are quartz- (silt and sand) free, but rich in mica and relict amorphous organic matter – some can be phytolith-rich; also other included soil variants are horizontally laminated (platy) with horizontally oriented long phytoliths, some displaying staining/infills (crust-like); trace examples of ash possibly pseudomorphic of herbivore dung; rare traces of charcoal and ashed monocotyledonous plants; trace examples of possible ashed twig wood?, and possible ashed laminar (cattle?) and convolute (sheep/goat) dung; trace amounts of cracked (fissured/ burned) clay papules – blackish brown limpid clay; *Fine fabric*: very dominant SMT 5), speckled and dotted grey to greyish yellow (PPL), mainly high interference colours (open porphyric, crystallitic b-fabric, XPL), grey, with occasional to many black specks (OIL); rare to occasional relict humic staining, trace to many fine charred organic matter; rare to many phytoliths; abundant patches of relict ash and ash crystals; *Pedofeatures*: (inclusion of papules); many micritic concentrations with some stronger formed void hypocoatings; trace amounts of acicular gypsum; very abundant burrowing and fabric mixing – partial total excremental fabric, including mammilated excrements; trace amounts of very thin excrements formed out of ash.	Prismatic, but not silty; calcitic with fine charred organics and phytoliths; inclusions of rounded, once-humic mica- and phytolith-rich soil/sediment and platy soil inclusions (trampled/tracked-in from wetland?); possible ashed herbivore dung; clay papules, possibly once-humic (stock trampling indicator?); burned human (and dog?) coprolites. *A dump of ashed anthropogenic materials, containing possible indications of weathered herbivore dung (stabling?) and human waste.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 5 / Soil Microfabric Type 5	Upper fill (347) of pit 390	**M5771b** (EC8)	375–450 mm As M5771a	As above, but stronger affect of roots and faunal mixing; many fine burned inclusions. *A dump of ashed anthropogenic materials, containing possible indications of weathered herbivore dung (stabling?) and human waste.*
Microfacies 5 / Soil Microfabric Type 5	Upper fill (348) of pit 390	**M5771c** (EC9)	515–590 mm As M5771a	As above, but less burrowed. *A dump of ashed anthropogenic materials, containing possible indications of weathered herbivore dung (stabling?) and human waste.*
	Lower fill (pale lens 384) of pit 390	**M10156** (See below)		See below
Microfacies 5 / Soil Microfabric Type 5	Middle fill (350) of pit 390	**M10779a**	0–70 mm (c. 590–660 mm) SM: as SMT 5, but broadly (20–40 mm) layered, with mm size coprolites containing cereal material, phytoliths and coarse bone (human/dog) or toilet waste/cess staining into matrix; burned platy humic soil inclusions; ash pseudomorphs of possible laminar structured dung (cattle?); with abundant silt and clay, or silt-dominated laminae (5 mm thick) and 3 mm wide u-shaped burrow infills and trace laminae of dusty clay.	Still laminated dumps of ash-rich material, with laminae and inwash of silt and silty clay. Inclusions of possible burned dung of cattle and sheep/goat, dumps of human cess and coprolites (dog/human). *As above but with silt and clay inwash.*
Microfacies 5 / Soil Microfabric Type 5	Middle fill (350–357) of pit 390	**M10779b**	70–145 mm (c. 660–735 mm) As SMT 5, with frequent inclusions of highly calcitic SMT 1a, sometimes iron and manganese stained; rare thin (200–400 µm) laminae of monocot? charcoal and long articulated phytolith lengths; trace amounts of secondary micrite void coatings.	*As above, but with deep subsoil inclusions, and possible input of cereal processing waste.*
Microfacies 5 / Soil Microfabric Type 5	Middle fill (369) of pit 390	**M10779c**	145–200 mm (c. 735–790 mm) SM: As SMT 5, with high amounts of burned daub, and possible relict ashed dung (see above) Probe: 2.07% Al, 8.42% Si, 10.63% Ca, 0.61% Mg, 0.11% Na, 0.87% K, 0.40% P, 3.89% Fe, 0.04% Mn, 0.55% Ti and 0.03% S. Elemental maps: the matrix is Ca (P) ash-rich, with Ca, K, Mg and P especially concentrated around a void as a pseudo-hypocoating, possibly formed from relict ashed dung; the many daub inclusions show concentrations of Si, Al, and K.	*A dump of ashed anthropogenic materials, containing possible indications of weathered herbivore dung (stabling?).*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 5 and 1b / Soil Microfabric Type 5 and 1b	Middle fill (373 upper) of pit 390	**M10778a**	200–270 mm (c. 790–860 mm) SM: heterogeneous, with burrow-mixed common SMT 5 and SMT 1b; with examples of fish bone, bone and human coprolites, and burned phosphatised daub/nodules; occasional secondary calcite.	*Burrowed mixture of ashed dumps and coprolitic material and strongly mixed soil and occupation debris.*
Microfacies 1b (with 5) / Soil Microfabric Type 1b (with 5)	Middle fill (373 upper) of pit 390	**M10778b**	270–340 mm (c. 860–930 mm) SM: as M10778a, but more homogeneous, with dominant SMT 1b, and frequent SMT 5; inclusions of small stone size micritic carbonate, occasional iron and manganese impregnation and trace amounts of clay infills; almost total excremental fabric.	*Occupation soil/natural soil dominated with small amounts of pure anthropogenic infill.*
Microfacies 1b and 1a (with 5) / Soil Microfabric Type 1b and 1a (with 5)	Lower fill (373 lower) of pit 390	**M10777a1**	360–435 mm (c. 0.930–1.005 m) SM: as M10778b, very dominant SMT 1b, with frequent SMT 1a and few SMT 5; an example of stone-size fragments of micritic carbonate, and rare bone and coprolite; abundant iron and manganese staining; almost total excremental fabric.	*Local subsoil soil and occupation soil-dominated with infrequent anthropogenic inclusions.*
Microfacies 5 over 1a–1b / Microfabric Type 5 over 1a–1b	Lower fill (373 lower) of pit 390	**M10777a2**	435–510 mm (c. 1.005–1.080 m) SM: broadly layered with an upper 30 mm of dominant (dung?) ash-rich SMT 5, and including a large (25 mm long × 8 mm broad) potsherd that includes thin relict monocotyledonous plant fragments (and their phytoliths) and once-humic dung-like matrix material. The lower 35 mm is composed of SMT 1a and 1b, showing laminar sedimentary features with pseudomorphs of horizontal plant fragments (elsewhere some as charred inclusions); also present are many intercalations, and rare amounts of secondary carbonate including root pseudomorphs, and Fe-Mn (and phosphate?) impregnation.	*Still-layered fill of burned debris (ashed dung?) over biologically mixed and burrowed subsoil and occupation soil fill. (Suggests 'weathering' of soil-rich fill, including wet soil inwash, prior to next phase of 'occupation' dumping)*
Microfacies 1a / Soil Microfabric Type 1a	Lower fill (378) of pit 390	**M10777b1**	510–585 mm (c. 1.080–1.155 m) SM: mainly homogeneous SMT 1a, with occasional charcoal and Fe-Mn nodules; occasional weakly formed intercalations, rare micritic hypocoatings; total excremental fabric with mammilated excrements.	*Biologically homogenised pit fill, formed by subsoil silting along with small amounts of charcoal.*
Microfacies 1a / Soil Microfabric Type 1a	Lower fill (384–385) of pit 390	**M10777b2**	585–660 mm (c. 1.155–1.230 m) SM: as M1077b1, but with fewer anthropogenic material; weakly developed iron depletion and abundant Fe impregnation, and very abundant micritic impregnation.	*Biologically homogenised pit fill, formed by subsoil silting, with secondary effects of gleying and carbonate deposition.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 1a / Soil Microfabric Type 1a	Lower fill (pale lens 384) of pit 390	M10156	0–75 mm SM: Dominant SMT 1a – finely speckled, pale grey (PPL), high interference colours (very open porphyric [coarse silt], parallel striate- speckled and crystallitic b-fabric, XPL), pale grey (OIL); trace amounts of organic matter and fine charcoal; *Pedofeatures*: rare 50 µm thick very finely dusty, often very pale, clay void coatings (vughs and planar voids); very abundant micritic calcite impregnation of soil matrix; occasional weakly formed Fe hypocoatings on prismatic planar voids, and coarse patches of soil; with a 2–5 mm wide layer of mainly wood (and Poaceae) ash crystals extending width (50 mm) of the slide. Probe (soil matrix): 5.96% Al, 19.65% Si, 2.13% Ca, 0.95% Mg, 0.17% Na, 2.1% K, 0.08% P, 3.88% Fe, 0.02% Mn, 0.30% Ti and 0.02% S. (n = 102) Elemental maps: Soil matrix is Si-Al dominated (clay and silt), with background Fe and K; mottled zones are Fe (and K) rich; ash layer is Ca-P rich; a Fe-P nodule is present.	*Dumps of deep subsoil clay; ash also deposited, including a major wood ash layer.*
DAUB	Upper occupation (305), SE Box	**M10780**		
	Daub	See daub below		
Microfacies 3 / Soil Microfabric Type 3	Main occupation, North Box, context 400, square F11	**M10781**	0–7.5 mm SM: generally strongly homogeneous SMT 3; although partially fragmented into medium subangular blocky structures, layer is characterised by only very few coarse anthropogenic inclusions (weakly burned daub); high amounts of charcoal and amorphous organic matter present as comminuted ('sorted') fine material; many to abundant intercalations (textural pedofeatures), compaction of earlier formed 'peds' with very thin clay infills between.	Loose fragments of dense occupation soil with well-sorted, very fine charcoal, intercalations and dusty clay coatings. *Probable beaten mud floor surface (protected by shell dump?).*
Microfacies 2b and 3 / Soil Microfabric Type 2b and 3	Main occupation, North Box, context 400, square D10	**M10782**	0–75 mm SM: similar to M10781, but much more heterogeneous with frequent SMT 3, and common SMT 2b; burned daub is in higher ('many') proportions and shell, rare traces of likely coprolitic bone, and sand size 'pale nodules' (x5; phosphatised silty soil) and fragments, occasional small patches of ash and burned coprolites are present.	Heterogeneous occupation deposit/surface that contains ashes, burned daub, burned coprolites and phosphatised pale nodules (from cess pits?). *A trampled surface that latterly underwent midden deposition.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 2c and 3 / Soil Microfabric Type 2b and 3	Upper fill (402–359) of pit 393	**M10783**	0–75 mm SM: Moderately homogenised mixture of SMT 2c and 3, with pseudo-platy structure; many burned daub, and trace amounts of coprolite and bone; charcoal only present as fine material; very abundant intercalations and many dusty clay infills and coatings; very abundant micritic impregnation and many Fe-Mn impregnation – secondary to textural features; parts of fill contain finely fragmented textural feature clay (papules).	Dense calcitic occupation soil fills with compact character and dark 'wetted' zones; intercalations and clay coatings (pre-dating secondary) calcium carbonate and Fe-Mn features; small papules present. *Pit fill of occupation soil – from trampled surface and likely earlier pit fill deposits of same character (papules); soil deposited in wet state or under heavy rain.*
Microfacies 5 and 2c / Soil Microfabric Type 5 and 2c	Main occupation CW Box, (327–342)	**M10784a**	70–145 mm SM: Extremely heterogeneous with SMT 5 and SMT 2c, including very abundant burned daub (10 mm example of D2), occasional bone, rare human coprolite and ashed herbivore dung, and traces of shell; very abundant Fe-Mn impregnation, rare micritic hypocoatings and clay coatings.	Heterogeneous, with probably dung-rich ashed remains, burned daub, occupation soil and human waste. *Midden.*
Microfacies 2a–5 / Soil Microfabric Type 2a–5	Main occupation CW Box, (342–351)	**M10784b**	145–210 mm SM: strongly homogeneous, as M10783, soil-dominated mixtures of SMT 2a and SMT 3, with occasional burned daub, rare to occasional bone/human coprolite/phosphatised soil ('pale nodules'); trace amounts of fish bone; once-compact; very abundant secondary micritic impregnation.	Occupation soil deposit, much likely cess waste; strongly homogenised and compact. *Aged and once-weathered and compacted upper pit fill of occupation soil and human waste.*
Microfacies 2a–5 (and 1a) / Soil Microfabric Type 2a–5 (and 1a)	Main occupation CW Box, (351–397)	**M10784c**	210–270 mm SM: as M10784b above, but with more fine charred material, and many burrow fills of calcitic SMT 1a.	*Aged and once-weathered and compacted occupation soil and human waste; with subsoil mixing – transition into 'natural'.*
	Upper fill (420 and 348) of pit 390	**M10785**	0–75 mm SM: juxtaposed 75 × 30 mm size clay insert (348) – SMT 1a (channel microstructure with very abundant diffuse Fe-Mn staining, composed of both clay and micaceous silty material) and ash-rich pit fill SMT 5 (as M5771a).	*Juxtaposed coarse micaceous silt and clay lump and heterogeneous ash-rich pit fill.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
TRENCH 23B DAUB				
Microfacies SMT D1 / Soil Microfabric Type SMT D1	Upper occupation(464, M15 right and M15 left), North Extension	**M14323** and **M14324 (Daub)**	Daub SM: Homogeneous; *Microstructure*: massive and compact; 5% voids, dominant 15 µm wide curved planes and few (relict/infilled) medium vughs; *Mineral*: (C:F), (limit at 10 µm), 30:70, *Coarse*: very well sorted very dominant coarse silt-fine sand-size quartz, few mica; with very few fine sand-size iron nodules and carbonate/fossils; SMT D1: *Fine fabric*: Interior: speckled reddish orange with grey patches (PPL), medium to high interference colours (close porphyric, speckled, with recticulate and patches of crystallitic b-fabric, XPL), orange (OIL); trace amounts of relict organic matter. *Fine fabric*: 'plaster edge': speckled dark blackish reddish brown (PPL), low interference colours or isotic (close porphyric, speckled and weakly retculate b-fabric, XPL), brown and greyish white (OIL); abundant relict amorphous organic matter (?). *Pedofeatures*: trace amounts of limpid clay coatings in fissure; occasional micritic calcite void infills and impregnations. Probe – interior: 7.94% Al, 20.1% Si, 4.51% Ca, 1.29% Mg, 0.19% Na, 3.32% K, 0.20% P, 3.89% Fe, 0.04% Mn, 0.55% Ti and 0.03% S (n = 48). Probe – 'plaster edge': 7.54% Al, 19.0% Si, 3.78% Ca, 0.76% Mg, 0.12% Na, 3.83% K, 0.16% P, 3.29% Fe, 0.02% Mn, 0.27% Ti and 0.03% S (n = 42).	A homogeneous, fine burned daub, *without* any plant tempering (like fine pottery?) manufactured from the local subsoil that still contains traces of original carbonate content (cf. M10156); pale 'plaster' edge seems to reflect a likely higher organic component and, from the microprobe quantitative analysis and elemental mapping, a relatively higher potassium (K) content. The presence of organic matter may have led to burning under reducing conditions, hence pale colours. Fine organic matter, possibly well-humified dung was added to the daub for the exterior wall surface, to aid weather proofing, dung relatively concentrating K (like Ca and P) – natural subsoil (2.10% K). (Post-depositional effects of calcium carbonate impregnation and traces of clay inwash). *Non plant-tempered burned daub made from fine subsoil/alluvium .*

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies SMT D2 / Soil Microfabric Type SMT D2	Upper occupation (464), North Extension	**M10780, M14325** and **M11884 (Daub)**	SM: Heterogeneous; *Microstructure*: compact with planar void microstructure; 30% voids, very dominant 200 µm to 0.5–1.0 mm wide planar voids, pseudomorphic of poaceae/reeds? plant tempering (sometimes represented by articulated sheets of phytoliths), up to 6 mm long; *Mineral*: (C:F), (limit at 10 µm), 40:60, *Coarse*: moderately well sorted very dominant coarse silt-fine sand-size quartz, few mica, (only traces of carbonate/fossils); *Coarse organic and anthropogenic inclusions*: very dominant inclusion of soil fragments/components, up to 8 mm in size (pale orange sandy loam with sedimentary layering and associated layered plant remains (alluvium – 10780); very dominant very dark reddish brown 'humic' soil, inclusions of relict amorphous organic matter with sometimes relict thin 150–350 µm size organo-mineral excrements (14325 and 11884); SMTD2: 10780 – speckled pale orange with reddish inclusions (PPL), medium to high interference colours (close porphyric, speckled and grano-striate with parallel striate [sedimentary) b-fabric, XPL), bright orange with red inclusions (OIL); abundant patches of abundant relict (rubefied) organic matter and occasional phytoliths. SMTD2: 14325 and 11884 – speckled and sometimes dotted dark reddish brown to black (PPL), isotic to very low interference colours (close porphyric, speckled b-fabric; XPL), orange to red, with red patches (OIL); very abundant relict amorphous organic matter; traces amounts of phytoliths (abundant phytoliths in planar voids). *Pedofeatures*: (post-depositional features) 10780 – abundant micritic and microsparitic (tufa-like) void infills and impregnations; trace of clay coatings; 14325 and 11884 – ubiquitous rare thin limpid clay void coatings; rare secondary calcitic impregnation and infills; rare Fe/Mn impregnation; occasional (fabric) biological infills of fine pale soil into voids.	Plant-tempered burned daub of two main types; 10780 – mixed organic matter with fine sandy alluvium; 11884 and 14325 – mainly topsoil employed, and still humic (see bulk chemistry). (Contemporary with fine daub in context < 464). *Plant-tempered daub manufactured from either sandy subsoil/alluvium or 'topsoil'.*
Microfacies SMT D1 / Soil Microfabric Type SMT D1	Experimental burned daub	**Exp. Burned Daub M1–3**	SM: Generally homogeneous; *Microstructure*: massive and compact, with cracked (fissured) microstructure; 25% voids, dominant medium to coarse (500 µm) moderately well accommodated planes and very few fine pseudomorphs of plant tempering; *Mineral*: (C:F), (limit at 10 µm), 30:70, *Coarse*: generally very well sorted very dominant coarse silt-fine sand-size quartz, with few fine to medium sand-size carbonate/fossils; very few gravel size concentric/pisolitic iron nodules; *Coarse organic and anthropogenic inclusions*: rare examples (x3 – Daub 3) of medium sand-size bone, rare traces of charcoal and charred rubefied plant fragments; very few burned (blackened) topsoil fragments; *Fine fabric*: speckled reddish orange with grey patches (PPL), medium to high interference colours (close porphyric, speckled, with recticulate and patches of crystallitic b-fabric, XPL), orange with few brownish inclusions (OIL); occasional amounts of relict organic matter and charred organic matter.	Like fine burned daub (SMT D1) of 464, M15 (M14323 and M14324), this is a generally homogeneous fine daub; only contrasting by containing occasional natural iron pisolites (from subsoil) and anthropogenic bone, soil, charcoal and plant remains.

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 3/ Soil Microfabric Type 3	Lower occupation (482/483), North Extension,	M14522a	40–115 mm SM: heterogeneous: *Structure*: poorly prismatic with dominant subangular blocky microstructure; 25% voids, with dominant poorly accommodated medium to coarse (1–4 mm) planes and frequent in-ped well accommodated curved fine (100 µm) planes, and very few in-ped fine to medium (100–500 µm) channels and chambers, very few fine (150–200 µm) closed vughs/vesicles; *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 40:60, *Coarse*: as SMT 2a (with coarse daub); *Coarse organic and anthropogenic inclusions*: many SMT D1) dung-rich micaceous fine sandy burned daub (max. 18.0 mm size), with major pore space thin clay coated; occasional SMT D2) dark brown charred daub and clay burned daub; rare traces of coprolite/bone? (x3); rare (x1) possible sand-size ashed herbivore coprolite; rare possible trace of biologically worked ash (in chamber); *Fine fabric*: very dominant (heterogeneous) SMT 3), lightly and very heavily speckled yellowish brown and dark yellowish brown (PPL), low, medium and moderately high interference colours (open porphyric, mainly speckled with minor granostriate, XPL); dark greyish brown, dotted (OIL); areas of many and areas of very abundant amorphous and charred organic matter; rare phytoliths; rare traces of ash; *Pedofeatures*: very abundant intercalations with associated rare thin (20–40 µm) void dusty clay coatings, e.g., closed vughs/vesicles and voids within large burned daub fragments; rare chamber fills of very thin <50 µm size organo-mineral excrements (Collembola?).	Humic and fine charcoal-rich topsoil material juxtaposed and strongly mixed with different burned daub types, and trace amounts of coprolitic bone and ash; mixing had formed intercalations associated with very thin dusty clay coatings and closed vughs, indicative of coarse mixing and slaking, interposed by biological activity. *These contexts probably represent mixed beaten floor/occupation deposit, likely formed under poorly protected (roofed) conditions. (Also possibility that general trampling by animals contributed to mixing)*
Microfacies 2a (and 2b) / Soil Microfabric Type 2a (with 2b)		**M14522b1**	150-250 mm SM: moderately heterogeneous; *Structure*: prismatic with crack microstructure; 20% voids, with dominant well accommodated medium (1–3 mm) planes and frequent in-ped well accommodated curved fine (20–50 µm) planes, and frequent in-ped fine to medium (100–500 µm) channels and chambers; *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 30:70, *Coarse*: very dominant well sorted very fine to coarse silt-size angular to subangular quartz, with frequent mica and sand-size (max. 1.5 mm) rounded iron and manganese nodules (PPL, black; OIL reddish black) and anthropogenic daub inclusions; *Coarse organic and anthropogenic inclusions*: rare SMT D1) dung-rich micaceous fine sandy burned daub (1200–3000 µm size blackish, convolute structure of mixed mica, fine sand and blackened organic matter, with relic plant tissue shapes and occasional phytoliths) juxtaposed to sand-size burned bone (other coarse – 5 mm – bone present), and many sand to gravel-size (5 mm) and stone size (30 mm) burned daub (clay with mainly coarse plant/reed? temper voids); and example of gravel-size carbonate rock; *Fine fabric*: as SMT 2a (patches of abundant fine amorphous organic matter and rare phytoliths), with rare SMT 2b; *Pedofeatures*: as **M14522b2**; very thin <50 µm size organo-mineral excrements present; frequent burrows and chamber fills.	Area 23B, North Extension, lower occupation layer (484): Humic topsoil that again records a history of fire maintenance; highly biologically worked with downward mixing of rare bone but many daub fragments (mostly burned). These are composed of two main types, a clay (*in situ* soil) type tempered with large plants (reeds?), and a dung-rich micaceous fine sandy type of non *in situ* origin. *Buried topsoil relict of a landscape kept open by fires, increasingly mixed with burned daub and other occupation materials. Previous arable activity?*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 1d (with 2b) / Soil Microfabric Type 1d (with 2b)	Lower occupation (485), North Extension	**M14522b2**	250–325 mm SM: generally homogeneous; *Structure*: prismatic with crack microstructure; 15–20% voids, with dominant well accommodated medium (1–3 mm) planes and frequent in-ped well accommodated curved fine (20–50 µm) planes, and frequent in-ped fine to medium (100–500 µm) channels and chambers; *Mineral*: Coarse:Fine (C:F), (limit at 10 µm), 10:90, *Coarse*: very dominant well sorted very fine to coarse silt-size angular to subangular quartz, with frequent mica and sand-size (max. 1.5 mm) rounded iron and manganese nodules (PPL, black; OIL reddish black); *Coarse organic and anthropogenic inclusions*: rare traces of medium (1 mm) root traces (channels), sand-size burned daub, very fine sand-size bone (x1) and occasional very fine charcoal; *Fine fabric*: very dominant SMT 1d) speckled and dotted yellowish brown (PPL), low to medium interference colours (porphyric, reticulate- and granostriate b-fabric, XPL), pale grey and yellowish grey, dotted (OIL); occasional to many amorphous organic matter and rare tissue fragments, with occasional fine charred organic matter, rare traces of phytoliths; few SMT 2b), as SMT 1d with high interference colours and crystallitic b-fabric (micritic impregnation); *Pedofeatures*: many coarse patches of pale ?iron-depleted soil fabric; occasional patches (e.g., root trace associated) of micritic impregnation and microsparitic void infill; rare trace of root pseudomorphs; many fine sand to medium sand-size impregnative, nucleic Fe/Mn nodules; occasional slickenside fabric features; very abundant welded excremental fabric with occasional broad organo-mineral excrements (including mammilated types) and burrow fills.	Presently prismatic structured soil with mottling due to gleying. It has a relict humic character and evidence of being totally biologically worked by plants and soil fauna. The very small amounts of included anthropogenic materials (apart from fine charcoal) indicate that this is a likely relict upper subsoil/topsoil transition, mainly only affected by 'clearance' (?) fires; or land kept open by fires. *Buried upper subsoil/topsoil transition relict of a landscape kept open by fires. Arable activity?*
Microfacies 2a / Soil Microfabric xType 2a	Upper occupation (469), West Extension, Square L10	**M14590**	0–75 mm SM: mainly homogeneous; as SMT 1a; *Microstructure:* massive with relic subangular blocky, with frequent (root) channels, as SMT 2a; planes commonly as bird foot shaped voids; *Coarse organic and anthropogenic inclusions:* trace amounts of bone, charcoal, roots; examples of human? coprolites, allocthonous soil and moderately coarse Poaceae/phytolith fragment (1600 µm); *Fine fabric:* as SMT 2a; abundant fine charred and many amorphous OM, rare red specks of burned fine soil; *Pedofeatures:* occasional patches (e.g., root trace associated) of micritic impregnation; many fine sand to medium sand-size impregnative, Fe/Mn nodules occasional coarse (8 mm) fabric mixing; abundant broad (2–3 mm) burrow fills, and rare very thin (50–100 µm) organo-mineral excrements – often in relic root channels.	This is presently a massive structured soil with relict subangular blocky; humic with much fine charcoal, but with only trace amounts of anthropogenic inclusions. Human modified topsoil, little affected by domestic occupation. Bird's foot planes are sometimes indicative of cultivation under wet soil conditions. *Arable soil?*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 2c /Soil Microfabric Type 2c	Upper occupation (422/445/464), North Extension	**M14631**	0–75 mm SM: moderately homogeneous with coarse burned daub (35 mm) etc in upper 20 mm; with homogeneous dark humic soil (as SMT 2b) but with coarse anthropogenic inclusions throughout, including rare to occasional bone and coprolitic fragments; also up to 4 mm size ash/relict ash concentrations, containing bone, charcoal, humic stained material (dung?); ash/micrite/microsparitic formations (from hearths); rare sand size examples of semi-vitrified burned soil; humic soil shows diminishing fine organic matter content down-profile; *Pedofeatures*: rare dusty and limpid clay coatings; many patches of micritic impregnation; moderately total biological fabric, with rare traces of thin <100 µm organo-mineral excrements.	Similar to 14779, but less mixing of humic topsoil with lower horizons and higher amounts of midden material; trampling is possibly responsible for dusty clay coatings. *Humic, once-arable(?) topsoil mixed with high amounts of (later) occupation/midden material.*
Microfacies 2c / Soil Microfabric Type 2c	Upper occupation (464), North Extension	**M14647**	0–75 mm SM: moderately heterogeneous, similar to SMT 1a, *Microstructure*: prismatic with subangular blocky; burrowed; 20% voids, dominant well accommodated medium (1–3 mm) planes and frequent in-ped well accommodated curved fine (20–50 µm) planes, and frequent in-ped fine to medium (100–500 µm) channels and chambers; *Mineral*: (C:F), (limit at 10 µm), 30:70, *Coarse*: very dominant well sorted very fine to coarse silt-size angular to subangular quartz, with frequent mica; rare traces of rounded iron and manganese nodules, pisolite-like; *Coarse organic and anthropogenic inclusions*: rare traces of charcoal, medium (1 mm) root traces (channels), root tissues and calcareous pseudomorphs of roots; traces of recent? root material; trace amounts of fine patches of humified organic matter; traces of human? sand-size coprolite (x2); rare very fine patches of ashes (?) and shell (max. 7 mm), rare bone (e.g., long fragment of 9 mm), sand-size example of allochthonous soil (coarse sand size, rounded micaceous sandy loam, containing trace amounts of diatoms and phytoliths); example of burned articulated Poaceae (130µm); many gravel to sand-size dark brownish, fine burned daub, and occasional reddish burned daub (local clay); trace amounts of rounded burned daub; *Fine fabric*: lower slide – dominant SMT 1a, with frequent SMT 2; upper slide – common as SMT 1 with many fine charred OM and rare to occasional phytoliths and common (burrow fills) as SMT 3, with abundant fine charred and many amorphous/tissue fragments, and occasional phytoliths; traces of ashes and fungal bodies; *Pedofeatures*: occasional patches (e.g., root trace associated) of micritic impregnation; example of slide long 2 mm wide channel/burrow fill; occasional coarse (8 mm) fabric mixing; abundant broad (2–3 mm) burrow fills, and rare very thin (50–100 µm) organo-mineral excrements – often in relict root channels.	This is currently a prismatic structured soil, with a humic and fine charcoal-rich character and evidence of being totally biologically worked by plants and soil fauna. The moderate amounts of included anthropogenic materials (including many burned daub fragments and rare bone and traces of allocthonous soil inclusions) indicate that this is a relict human modified topsoil (arable?), adjacent to domestic human occupation. *Relict human modified topsoil (arable?), adjacent to domestic human occupation.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 2b (with 1a-1c) / Soil Microfabric Type 2b (with 1a–1c)	Occupation (452/600), West Extension	**M14758**	0–75 mm SM: heterogeneous, with common SMT 1b/1c and common SMT 1a (large – 30 mm) size burrow fill and frequent SMT 2b; prismatic with subangular blocky; planes commonly as bird foot shaped voids; *Coarse organic and anthropogenic inclusions*: rare burned daub and charcoal, and trace amounts of bone; *Fine fabric*: here SMT 2b contains abundant fine charcoal, many amorphous organic matter, rare to occasional phytoliths, trace amounts of plant tissues; *Pedofeatures*: as SMT 2a–1c, with many very coarse (4 mm wide) relic areas of intercalatory infills (SMT 1b–1c/3) sometimes developing into trace amounts 40 µm thick dusty clay void coatings; rare to occasional in places, limpid to dusty clay void coatings and infills (40–200 µm), especially around coarse fragments of SMT 1a (large burrow).	Several episodes of mixing are evident; a last one with very coarse burrow mixing, seemingly followed by fine to limpid clay inwash. Earlier mixing introduced humic and charcoal rich soil into voids, with likely inwash leading to intercalatory features and dusty clay coatings. The soil displays bird's foot planes (from wetting?). The rare amounts of anthropogenic inclusions imply this is not a domestic occupied area. *Arable soil?*
Microfacies 2c / Soil Microfabric Type 2c	Lower occupation (486–493), West Extension	**M14779**	0–75 mm SM: heterogeneous; as (M14631); with (in top 30 mm) very dominant, coarse (25 mm) daub fragments (rubefied with long pseudomorphs – voids – of plant tempering; non-rubified (unburned) daub of same kind; fewer gravel size dark brown humic daub (with relict plant tempering; sometimes with included coarse 3 mm size carbonate); inclusions of coarse (3 mm) subrounded carbonate and shell fragments; major juxtaposed mixing of common very dark humic a and less dark less humic type b; much inclusion of medium to coarse sand size very dark brown to blackish, burned humic soil: abundant fine carbonate fragments; rare traces of bone; *Pedofeatures*: rare traces of dusty clay coating and intercalations in some humic soil areas; very abundant impregnation with micrite; very abundant fabric mixing – including very broad 4 mm burrow fills.	Occupation soil of types SMT 2a and SMT 2b, which has undergone bioturbation since upper layer mixed with burned daub and daub from near *in situ* structures. *Once-arable (?) humic soil mixed with (later) large amounts of burned structural and occupation debris.*
TRENCH 23C				
Microfacies 1a–1b / Soil Microfabric Type 1a–1b	XY14–15, upper levels (512–514)	M9381	0–75 mm SM: as SMT 1a–1b, with only occasional fine charcoal and amorphous organic matter; rare traces of bone and phosphatised soil ('pale nodules'); many to abundant intercalations, with some sorting into dusty clay; very abundant Fe-Mn diffuse impregnation; occasional infills of iron-depleted soil and fabric mixing of iron depleted soil; occasional micritic impregnation. No difference between 512 and 514.	Dense fine soil formed from small amounts of anthropogenic inputs (including likely human waste) and subsoil/alluvial soil; mottled, with inwash of gleyed soil (flooded?) and possible disturbance (trampling?); secondary groundwater deposition of carbonate. *No real differentiation between Natural and shallow scoop infill – likely local silting with occasional flood/wetness and trampling? Events effects.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 5 / Soil Microfabric Type 5	XY14–15, fill of shallow pit/scoop; basal part complemented by 9644	**M9641a1**	0–75 mm SM: As below (SMT 5), with fewer traces of ash pseudomorphs of woody tissues; increasing transformation of individual ash crystals into micritic mass; trace amounts of bone and coprolite, with rare charcoal; many 1–4 mm size daub and burned daub; e.g., of coarse 3 mm size Fe/Mn impregnative nodule; many dusty clay coatings, sometimes microlaminated.	Increasingly weathered up-profile – wood ash-rich deposit; with many burned daub and trace amounts of middening. *Increasingly weathered and biologically worked ash fill (with middening), from wood fires, but possibly also stabling refuse? Likely flood events recorded through wetting and clay inwash; gleying.*
Microfacies 5 / Soil Microfabric Type 5	XY14–15, upper part of pit/scoop fill	**M9461a2**	75–150 mm SM: As below (SMT 5), with fewer traces of ash pseudomorphs of woody tissues; increasing transformation of individual ash crystals into micritic mass; trace amounts of bone and coprolite, with rare charcoal; many 1–4 mm size daub and burned daub; e.g., of coarse 3 mm size Fe/Mn impregnative nodule; many dusty clay coatings, sometimes microlaminated.	Increasingly bioturbated wood ash, with daub and soil, minor charcoal and traces of bone. Important structural formation (prisms), rooting and burrowing and increasing amounts of Fe/Mn. *Increasingly weathered and biologically worked ash fill (with middening), from wood fires, but possibly also stabling refuse? Likely flood events recorded through wetting and clay inwash; gleying.*
Microfacies 5 / Soil Microfabric Type 5	XY14–15, pit/scoop fill	**M9461b1**	180–255 mm SM: As below (SMT 5), with more (occasional) charcoal; traces of shell, coprolite and bone (traces), e.g., of 2 mm long fish bone; rare inclusion of burned soil as well as unburned and poorly burned plant tempered daub; development of prismatic structure, 2–3 mm wide deep (50 mm) fissures, some used by earthworms (broad organo-mineral excrements); occasional very thin to coarse, probable insect burrows with secondary clay coatings and loose matrix infills; trace amounts of iron and manganese staining, and a 5 mm patch of secondary carbonate infill; trace of likely phosphate void infills; occasional dusty clay coatings.	Increasingly bioturbated wood ash, with daub and humic soil, minor charcoal and traces of bone, including fish bone. Important structural formation (prisms), rooting and burrowing and increasing amounts of Fe/Mn and carbonate formation; clay inwash. *Increasingly weathered and biologically worked ash fill (with middening), from wood fires, but possibly also stabling refuse? Likely flood events recorded through wetting and clay inwash.*
Microfacies 5 / Soil Microfabric Type 5	XY14–15, lower fill of pit/scoop	**M9461b2**	280–355 mm SM: As M9644, probable wood ash-dominated, with organic and fine soil traces and fine inclusions; frequent coarse burned daub, and plant tempered pot/daub material (SMT D2); example of sand-size fragment of burned silty sediment (alluvium?); rare phytoliths; trace amounts of root channels and associated very thin <50 µm excrements (of ash); occasional dusty clay void coatings, sometimes microlaminated with dusty laminae, up to 600 µm coarse void/channel infills; coated vesicles present.	Moderately strongly bioturbated ash-rich dumps, with rare shell, bone and coprolitic remains. Ash comes dominantly from wood fires, but inclusions of humic soil and phytoliths, possibly suggest woody browse/dung is a component. Minor secondary rooting, micritic impregnation and important clay inwash (alluvium?). *Ash fill (with middening), from wood fires, but possibly also stabling refuse? Likely flood events recorded through wetting and clay inwash.*

Table 11.3. Continued

Material	Context	Sample Number	Relative sampling depth, Soil Micromorphology (SM), Bulk Data (BD). For sample contexts see also chapter 9.	Phase, Interpretation and Comments
Microfacies 5 / Soil Microfabric Type 5	XY14–15, basal fill of pit/scoop	**M9644**	0–75 mm SM: Ash-rich (phytoliths-free) SMT 5 (especially upper part; lower part more silt and clay rich and more weathered); very dominant dotted greyish brown (PPL), medium to high interference colours (open porphyric, crystallitic b-fabric, XPL), grey with black specks (OIL); abundant humic staining, many fine charred OM, very abundant ash crystals, and occasional silt-size quartz; rare phytoliths; (also variant with little ash, but occasional phytoliths, silt and clay and humic matter); some rare examples, up to 3 mm across of relict layered ash material (traces of woody tissue cattle dung?); also weak humic/phosphate staining; abundant burrowing, but with rare traces of human coprolite (showing partial micritisation), root pseudomorphs; silt/fine sand-filled aestivation chambers; occasional to many fine charcoal, rare traces of shell and bone, with rare traces of secondary amorphous phosphate infills and secondary dusty clay coatings; rare gravel size inclusions of humic soil with abundant phytoliths (articulated sheets of Monocot); only occasional burned daub inclusions (e.g., with attached monocot fragment with articulated sheets of phytoliths); coarse mixing of all but decalcified and still calcitic material; abundant intercalations calcitic infills and some rare void clay coatings, especially in middle part of thin section; many secondary micritic carbonate impregnation; fabric mixing and burrowing, especially in lower half.	Moderately strongly bioturbated fine charcoal-rich ash dumps, with rare shell, bone and coprolitic remains. Ash comes from wood fires and possible cereal processing waste, but ashed dung may also be present. Minor secondary rooting, micritic impregnation and clay inwash. This earlier fill was truncated and the slightly more ash-rich upper part (overlying fill) was deposited in wet state. *A two-phase ash fill with a likely period of weathering and subsoil mixing of the 1st phase prior to dumping of 2nd phase (0under wet conditions or soon flooded).*
Microfacies 5 (2a)/ Soil Microfabric Type 5 (2a)	XY14–15, above child skull burial (542/543)	**M9674**	SM: as M9641a2 (SMT 5), but with higher amounts of human? coprolites (up to 2.5 mm) and bone, including fish bones (eg x3); strongly burned soil (vesicular and partially melted quartz); very abundant burrowing and organo-mineral excrements (bringing in humic SMT 2a soil), with secondary very abundant dusty clay coatings.	Wood (?) ash, bone and coprolite-rich midden deposit. (Major secondary bioturbation/weathering and clay inwash). *Increasingly weathered and biologically worked ash fill (with middening), from wood fires, but possibly also stabling refuse? Likely flood events recorded through wetting and clay inwash; gleying.*

Results

These are presented in *Tables 11.2* (counts), *11.3* (descriptions) and *11.4* (microprobe). Soil microfabric types, anthropogenic inclusions and microprobe maps showing the distribution of elements, are illustrated in *Figs 11.1–8*.

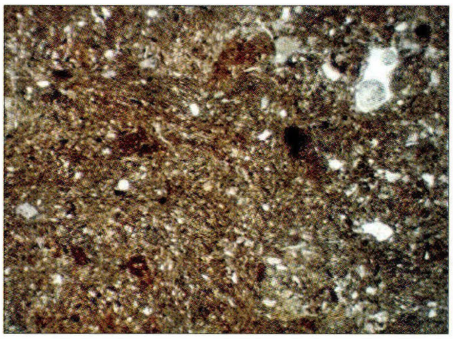

Fig. 11.1. Photomicrograph: M14324; fine daub SMT D1; showing homogeneous well-sorted silty clay grain size and 'pattern' from mixing; material is rubefied in colour – from heating. Plane polarised light (PPL), frame width is 2.1 mm

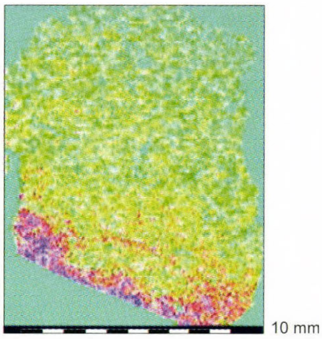

Fig. 11.2. M14323 – elemental (K) map; 'pale' daub edge is marked by a concentration of K. Burned daub shows very high $\%_{conv}$ due to burning (see *Tables 11.3–4* and *12.2*)

Fig. 11.3. M10780 – scanned image of thin section; note heterogeneous character of plant- (reed?) tempered daub (SMT D2); dark colours reflect rubefication from heating (see *Table 12.2*). Thin section is ~55 mm long

Fig. 11.4. M14631 – scanned image of thin section of context 464, the buried soil (with peak of phosphate at this level – see *Table 12.2*). This humic, once-arable (?) topsoil is mixed with high amounts of anthropogenic inclusions – coarse burned daub, ash, charcoal and fine bone and coprolitic fragments (SMT 2c). Thin section is ~65 mm long

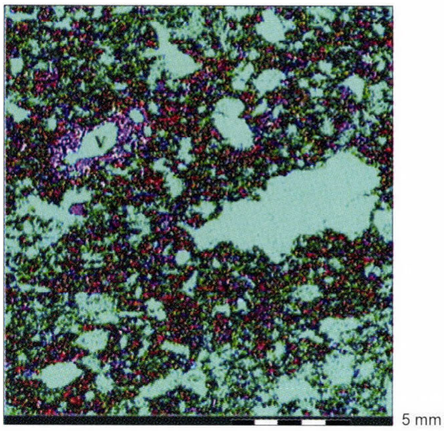

Fig. 11.5. M10779c – elemental (Ca) map showing calcium carbonate-rich matrix of part weathered ash, showing a void (V) formed in a locally secondary calcium carbonate enriched area

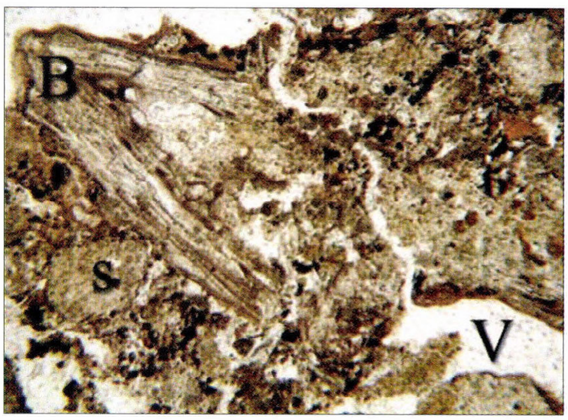

Fig. 11.7. Photomicrograph: detail of soil (S) and bone (B) dumped into Pit 390 (M5771a) (SMT 5); heterogeneous mixture including very fine black charcoal. The bone is of likely coprolitic origin. PPL, frame length is ~0.9 mm

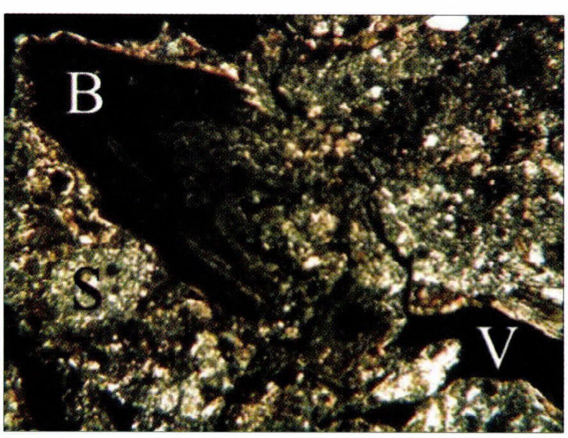

Fig. 11.8. As *Fig. 11.7*, but under crossed polarised light, showing silty character of the soil, form birefringence of the bone and totally isotic ('black') nature of the resin-filled void (V)

Fig. 11.6. Photomicrograph: detail of void in M10779c (SMT 5) identified (V) in *Fig. 11.5*; microprobe elemental maps show that the matrix is Ca(P)-rich relict ash, with Ca, K, Mg and P especially concentrated around the void as a pseudo-hypocoating; fine organic inclusions in the weathered ash may indicate the presence of burned dung here. PPL, frame width is ~3.4 mm

Discussion

Results are discussed in the light of:

1. post-depositional processes that affect the level to which the soil micromorphology can be interpreted, and the identification of broad Soil Microfacies Types (SMTs);
2. the characterisation and identification of soil, sediment and anthropogenic material types; and
3. the tentative interpretation of the microstratigraphic sequences across the site.

Post-depositional processes and soil microfacies types (SMTs)

When identifying and interpreting soil microfabrics post-depositional effects have to be considered (Courty *et al.* 1989). The site is biologically active at the present day, with rooting and burrowing by various invertebrates (e.g. earthworms, insects) mixing and at times homogenising the soils and deposits. The clay-rich soils are also subject to shrink and swell, which like faunal mixing, contribute to the comminution of such weak materials as charcoal. Shrink and swell also produce the distinctive birefringent-fabrics found in, for example, SMTs 1a–3 (see below). Ash deposits (below), because these are not clays, have not suffered from shrink and swell. The soils and deposits at the site have undergone effects of both poor drainage, leaching and movement of Fe (iron), Mn (manganese), and carbonate ($CaCO_3$). The uppermost levels of the site have undergone the likely loss of $CaCO_3$ from once-ash-rich deposits during the latter half of the Holocene (301–335; M5769a), and rooting has also affected these upper levels. This has led to probable thinning of the stratigraphy, and a possible artificial concentration of phosphate. Ubiquitous channel void patterns testify to rooting by plants throughout the history of the site, up to modern times.

Groundwater, poor/impeded drainage conditions (silty clay soils) and flooding have affected the site. It is likely that groundwater has had the effect of both leaching of and impregnation (redistribution) by carbonate. Poor drainage has produced Fe-Mn mottling, which can also be found in lumps of natural clay soil, as found for example in context 348 in the fill of pit 390. Although the evidence is not always unequivocal, some clay inwash features (textural pedofeatures of finely dusty to limpid clay void coatings and infills, some microlaminated) may be the result of flood/alluvial events, for example through pit fills in Area 23C (samples 9381, 9641, 9644, 9674), but such events may post-date the Neolithic by many millennia. Some clay inwash and slaked anthropogenic deposits such as ash may also be the result of deposition under wet conditions, for example when dumped as slurry, or when ephemerally rain-filled poorly draining pits are used (as in the Early Iron Age ditch at Maiden Castle, Dorset, UK: Macphail 1991). Dumping itself weakens the structure of soil, which can lead to rain-induced clay movement, as possibly recognised in Trench 23A, although again the effects of (post-depositional) alluvial flooding and rain-filled pits cannot be ruled out.

All the above have contributed to the difficulty of making finely tuned interpretations of the soils and deposits of the site. In addition, human and probable animal trampling, and as yet un-identified human activities and cultural practices, have also led to mixing of soil and anthropogenic materials. Ecsegfalva is not a protected site, such as a cave, where delicate ash-rich Neolithic stratigraphy can remain little altered for 5–6,000 years, as in various Italian and French limestone regions (Wattez *et al.* 1990; Macphail *et al.* 1997; Boschian and Montagnari-Kokelji 2000). Nevertheless, sufficient stratigraphy is preserved to enable the use of the more intact material from sites like Neolithic Arene Candide in Liguria, Italy, to gain some possible insights into the cultural activities at Ecsegfalva (see below).

As a result of post-depositional processes, some occurring during the lifetime of the site, only broad soil microfacies types (SMTs) have been identified *(Table 11.3)*, namely:

SMT D1: non plant-tempered daub/burned daub (samples 14323, 14324, and experiments) *(Figs 11.1–2)*;
SMT D2: plant-tempered daub/burned daub (samples 10780, 14325, 11884) *(Fig. 11.3)*;
SMT 1a: deep subsoil containing only trace amounts of organic matter and anthropogenic materials (as at the base of pit 390);
SMT 1b: strongly homogenised mixture of subsoil and occupation materials/soils (e.g. in some pit fill contexts);
SMT 1c: partially (and still heterogeneous) mixture of subsoil and occupation materials and soils (e.g. in some pit fill contexts);
SMT 1d: upper subsoil that is weakly mixed with anthropogenic materials (*in situ* natural soil influenced by overlying occupation soils; e.g. sample 14522b2, context 485);
SMT 2a: humic topsoil with moderate amounts of included anthropogenic materials (*in situ* soils; e.g. sample 14522b1, context 484);

SMT 2b: as SMT 2a, but with higher concentrations of secondary carbonate;

SMT 2c: upper subsoil that is strongly mixed with anthropogenic materials (*in situ* soils; e.g. sample 14779, context 486) *(Fig. 11.4)*;

SMT 3: as SMT 2a (and SMT 2c), but with finely sorted included material, and often compact (e.g. sample 14522a, context 482/483; sample 10781, context 400);

SMT 4a: probably weathered and leached upper occupation soil (e.g. sample 5769a, context 301–335);

SMT 4b: probably little weathered and leached upper occupation soil (e.g. sample 5769b, context 301–335?); and

SMT 5: ash-rich dumps that can also contain midden and human faecal waste (e.g. upper fill of pit 390) *(Figs 11.5–8)*.

For details see *Tables 11.2–4*.

Table 11.4. Ecsegfalva soil micromorphology; microprobe analysis of samples M14324 (non-plant tempered fine daub, e.g. of 'pale' edge and interior of daub at 5–10 mm); M10779C (ash in pit 390) and M10156 (subsoil lens in pit 390)

	Al	Si	Ca	Mg	Na	K	P	Fe	Mn	Ti	S
14324: 'pale' edge of daub											
Mean	7.54	19	3.78	0.76	0.12	3.83	0.16	3.29	0.02	0.27	0.03
Std. Dev.	4.38	8.31	3.37	0.63	0.11	2.18	0.19	1.97	0.03	0.27	0.02
Max.	17.5	32.9	15.1	3.28	0.42	7.76	0.82	8.54	0.17	1.22	0.08
Min.	0	0.02	0.01	0	0	0.005	0	0.01	0	0	0
Range	17.5	32.9	15.1	3.28	0.42	7.75	0.82	8.53	0.17	1.22	0.08
n	42	42	42	42	42	42	42	42	42	42	42
14324: 'interior' daub											
Mean	7.94	20.1	4.51	1.29	0.19	3.32	0.20	3.89	0.04	0.55	0.03
Std. Dev.	3.32	6.75	4.74	1.89	0.32	1.46	0.47	3.25	0.08	2.52	0.04
Max.	15.3	32.2	20.4	10.5	1.59	6.81	3.26	18.9	0.48	17.6	0.27
Min.	0.22	0.02	0.33	0.18	0	0.11	0	0.28	0	0.003	0
Range	15.1	32.2	20	10.3	1.59	6.71	3.26	18.6	0.48	17.6	0.27
n	48	48	48	48	48	48	48	48	48	48	48
10779C: ash-rich											
Mean	2.07	8.42	10.63	0.61	0.11	0.87	0.40	1.38	0.09	0.18	0.01
Std. Dev.	2.62	9.64	11.1	0.66	0.29	0.96	1.04	1.9	0.43	0.49	0.02
Max.	8.88	33.53	36.86	4.7	2.42	3.62	9.62	12.01	4.34	3.48	0.12
Min.	0	0	0.06	0	0	0	0	0	0	0	0
Range	8.88	33.53	36.8	4.7	2.42	3.62	9.62	12.01	4.34	3.48	0.12
n	102	102	102	102	102	102	102	102	102	102	102
10156: subsoil											
Mean	5.96	19.65	2.13	0.95	0.17	2.10	0.08	3.88	0.02	0.30	0.02
Std. Dev.	2.94	6.33	3.18	0.54	0.31	1.09	0.08	2	0.03	0.35	0.06
Max.	23.84	37.22	17.74	4.55	2.8	6.27	0.71	13.81	0.22	2.79	0.51
Min.	0.08	0.15	0.07	0.03	0	0	0	0.04	0	0	0
Range	23.77	37.07	17.73	4.52	2.8	6.27	0.71	13.78	0.22	2.79	0.51
n	102	102	102	102	102	102	102	102	102	102	102

Daub

Large amounts of daub, especially burned daub, are found at Ecsegfalva 23 (chapter 9; and see also chapter 13). The study of reference samples and experimental material found that two broad types could be distinguished. These are a non plant-tempered type (SMT D1) and a plant-tempered type (SMT D2).

SMT D1: This is a 'clay'-dominated (defined as < 10 μm size = 70%) fine daub with (30%) well-sorted fine sand and silt *(Fig. 11.1)*. Some examples, from a house structure or possible oven in the uppermost occupation in the North Extension of 23B (chapters 9 and 13), have a 10–14 mm wide pale edge or surface, and this has been studied through both soil micromorphology and microprobe. There is little mineralogical difference between the pale surface and the more dark brown daub *(Table 11.3)*. The only measurable dissimilarity is the higher amount of potassium (K = 3.83%, n = 48) present in the pale surface, compared to the interior of the daub sample (14324; K = 3.32%, n = 42) *(Table 11.4, Fig. 11.2)*. These amounts of K are greater than found in a typical example of the subsoil material at Ecsegfalva (sample 10156; K = 2.10%, n = 102) and possibly result from additions/inclusions of fine organic matter/dung (Macphail *et al.* 2004), as in the hearth of the reconstructed Iron Age house from Pimperne, at Butser (Goldberg *et al.* in preparation). The possibility that the pale surfaces contain more relict (oxidised) fine organic remains (fine humified dung?) than the interior was noticed, and so the pale colour may also reflect the chance of the daub being burned in reducing conditions induced by a higher organic content, and where such reducing conditions increase magnetic susceptibility enhancement (John Crowther, *pers. comm.*; Thompson and Oldfield 1986; Crowther and Barker 1995) (and see Crowther, chapter 12). If this fine daub has an oven origin (chapter 13), the correlation between the pale edge and concentration of K may reflect the possibility that this layer comes from the floor surface of the putative oven or kiln where K-rich ash was likely present (John Crowther, *pers. comm.*).

SMT D2: This other type of daub is rich in both relict coarse plant tempering and included fine organic matter (dung?). The last was also noted as a possibility from the chemistry of sample 10780 (chapter 12). Plant tempering has produced large parallel-sided planar voids that are the likely pseudomorphs of oxidised reeds *(Fig. 11.3)* (see chapter 13). Traces of the plant material, especially their relict phytoliths, are often present. A number of variants of this daub type were recognised. Although in general the daub averaged some 60% fine material, there were fine, 'clay'-dominated types, and some with higher proportions of silt, fine sand and mica. These plant-tempered daub types could also contain humic topsoil fragments, some containing phytoliths.

Soil

The soil types SMT 1a–1c are detailed in *Table 11.3*. These have been formed through the deep weathering of a likely loess-enriched alluvium that developed on the Pleistocene levée of Kiri-tó, producing clay rich alluvial gley soils/Gleysols. It can be noted here that the site lies within the broad region of the Danubian Steppe where some 500–600 mm of precipitation (modern figures) have produced a regional soil cover of Calcaric Chernozems (FAO-Unesco 1988). Occupation (see below for suggested stratigraphic history) led to anthropogenic material becoming mixed with natural soil, sometimes because subsoil silting of large pits was accompanied by both anthropogenic inputs and biological activity. The degree to which soil and anthropogenic inclusions are homogenised is a proxy indicator of time between dumping episodes, for example in pits. In

23A, infills of SMT 1b (strongly mixed) imply a slower rate of, or gap between, dumping/silting events, compared to SMT 1c (partially mixed).

The buried soil types in the north and west extensions of 23B show the increasing influence of cultural activity on the soil down to around 300 mm below a major occupation surface or level (e.g. context 464; *Fig. 11.4*), as also picked out by the phosphate chemistry *(Table 12.1)*. SMTs 2a and 2b are dark silty clay soils with well developed reticulate and granostriate birefringent fabrics, characterised by fine organic matter, fine charcoal and phytoliths. They contain small amounts of coarse anthropogenic inclusions (compared to SMT 2c). Both the stratigraphic position and soil micromorphological nature of SMTs 2a and 2b indicate that this material is the ancient topsoil at the site, which formed at 23B prior to the major occupation forming context 464. Organic matter and fine charcoal were finely integrated into this topsoil prior to occupation 264. The soils generally contain little or no textural pedofeatures (e.g. clay coatings and infills; 14758 is an exception), or even fragments of such features (papules); even whilst both *in situ* and fragmented textural features are present elsewhere at Ecsegfalva. Therefore there are generally no clear textural feature indications of clearance, cultivation or stock concentrations (Courty *et al.* 1989; Macphail *et al.* 1990; Macphail 1992; Courty *et al.* 1994; Macphail *et al.* 1998). On the other hand, a homogeneous, fine, charcoal-rich topsoil still requires explanation. First of all, this soil implies a land use that probably involved management of the naturally open vegetation (see chapter 6) by fire (e.g. Macphail 1990; Gebhardt 1993). The possibility that the area was used for arable farming cannot be discounted, nor that the charcoal-rich homogeneous soil is the result of this. There are both ethnoarchaeological and experimental data that indicate that textural features are only one form of evidence to support an identification of ancient cultivation (Macphail 1998). High biological activity and well-developed structural formation are the result of modern/recent horticulture, as reported from the Scottish Isles (Simpson 1997), and as found at both the Demonstration Area and Little Butser Hill at Butser Ancient Farm (Gebhardt 1990; 1992; Macphail *et al.* 1990; Lewis 1998; Goldberg *et al.* in preparation). The coarser clods formed by, and typical of, cultivation at Butser were also reworked into smaller crumbs by soil fauna only after a few months (Macphail, personal observation; Anna Gebhardt, *pers. comm.*, Goldberg *et al.* in preparation). At Butser high amounts of calcium (Ca^{++}) help bond peds through flocculation, and the soils at Ecsegfalva are equally rich in Ca *(Table 12.4)* (note that modern alkaline pHs may reflect the recent effects of salinisation – formation of a salty soil – induced by a poorly conceived irrigation programme: Pál Sümegi, *pers. comm.*). Gebhardt (1990) found that when she cultivated clay soils under water saturated conditions a compact soil formed that was characterised by 'bird's foot' voids. Such voids can be present in SMTs 2a and 2b. Post-depositional shrink and swell have also affected these soils that can be described as slowly draining (and as reported from the buried old ground surface at the Overton Down Experimental Earthwork; Bell *et al.* 1996; Crowther *et al.* 1996). In summary, although the evidence for cultivation at Ecsegfalva is highly equivocal this land use prior to the building of structures and intensive occupation/middening has to be considered as a possibility.

SMT 2c *(Fig. 11.4)* is similar to SMT 2a and 2b, but contains very abundant amounts of anthropogenic inclusions, such as burned daub, burned soil, allocthonous soil, shell, fine charcoal, ash, fragments of articulated sheets of phytoliths (monocotyledonous plants), human coprolitic material, burned bone and possible pseudomorphs of ashed herbivore dung. It is also characterised by dusty clay textural pedofeatures that could imply physical disturbance, e.g. by trampling. This SMT 2c can be regarded as representing intensive human activity.

SMT 3 is similar to SMT 2c, but there are sufficient differences to be able to make a more specific interpretation, for example in context 482/483 (in the sondage below the burned daub concentration 458 in the North Extension). Here, occupation soil with ubiquitous anthropogenic inclusions contains partially coalesced/juxtaposed soils with both very high and medium amounts of fine charcoal. They contain well-sorted fine included mineral material. Textural pedofeatures are present as both very abundant intercalations and rare dusty clay coatings. There are therefore indications of beaten floor formation (as at the Pimperne House, Butser; Macphail and Cruise 2001; Macphail *et al.* 2004) and coeval mixing of this beaten floor material of different kinds, as found on prehistoric occupation sites where post-depositional trampling and biological activity have taken place (Courty *et al.* 1989; Macphail 1999).

These SMTs 2a–2c and 3 are discussed further in the microstratigraphic sequence, below.

Ash deposits

Ashes, the mineral material relict of burned plant remains (wood, leaves, cereal and reeds) and dung (composition varying with diet), are formed out of calcium carbonate ($CaCO_3$; ~20 µm size cubic wood ash crystals; *Figs 11.5–6*), calcium oxalates (e.g. druses in roots and leaves), and phytoliths (cereals, grasses, reeds), and may also include faecal spherulites (biogenic $CaCO_3$ found in dung of domestic stock, especially sheep/goat) (Francheschi and Horner 1980; Brochier 1983; Wattez and Courty 1987; Wattez *et al.* 1990; Brochier *et al.* 1992; Canti 1997, 1998, 1999). These materials, however, are subject to weathering, with faecal spherulites disappearing over one season even under Mediterranean conditions and calcium oxalate readily becoming transformed into micritic (microcrystalline < 5 µm) calcite, which makes the exact origins of some ash deposits difficult to identify (Brochier *et al.* 1992; Boschian 1997; Macphail *et al.* 1997; Canti 1999; Boschian and Montagnari-Kokelji 2000). Neither faecal spherulites nor obvious calcium oxalate crystals were observed at Ecsegfalva. Under the temperate, moist conditions of Hungary, weathering processes (and biological mixing) have transformed much of the ash deposits at Ecsegfalva. Nevertheless, prehistoric analogues of ash-rich pit fills and 'midden' sites in the UK suggest that some global interpretations can be attempted (Macphail 2000; Macphail and Crowther 2002). At Ecsegfalva it can also be noted that secondary $CaCO_3$ features result from this weathering, as well as some secondary phosphate features. Quantitative microprobe and element mapping of an example of an ash dump (10779c, in the middle fill of pit 390) showed a concentration of Ca (10.63%), over Si (8.42%) and Al (2.07%), with 0.40% P being present *(Figs 11.5–6).*

Amongst the ash deposits present at Ecsegfalva, burned soil material other than daub is present. There are examples of soil having been burned at high temperatures (800°C), which are revealed by the silt and fine sand-size quartz displaying a melted morphology and formation of a vesicular porosity within the relic soil clast (Courty *et al.* 1989). This has probably occurred through occasional flaring in generally low temperature (400–600°C) fires. In the upper fills of Pit 390, there are a number of weakly burned fragments of commonly rounded soil. There are some allocthonous clasts that are free of quartz (silt and sand), but rich in mica and relict amorphous organic matter, and some can be phytolith-rich. Other included non-rounded soil fragments are horizontally laminated (platy) with horizontally oriented long phytoliths, some displaying staining/infills, making them appear crust-like in appearance. These soil inclusions in this ashy SMT 5 appear to testify to the trampling-in of humic and possible wetland soil into once-organic deposits that were then burned. Of further interest are trace amounts of cracked (fissured/burned) clay papules composed of blackish brown limpid clay, that are unlike the clay coatings and infills that are found commonly as secondary features on the site (see above). Some ash fragments can possibly be identified as poorly pseudomorphic of burned dung (possibly from cattle and sheep/goat). This material is clearly different from ashes that contain articulated phytoliths and charred remains of monocotyledonous plants, and which are the probable remains of cereal processing/burning of reeds.

The above observations may imply that part of the ash input is from the burning of 'stabling' refuse. This can be argued from the combination of the following at Ecsegfalva:

1. Ash, appearing to be relict/pseudomorphic of dung (Wattez *et al.* 1990; Boschian 1997; Macphail *et al.* 1997; Boschian and Montagnari-Kokelji 2000);
2. Allocthonous rounded soil clasts and laminar fragments showing compaction (and crust formation) due to animal trampling/soil poaching, trampled-in from around the site and from wetland where grazing and drinking have taken place (Beckman and Smith 1974; Kemp *et al.* 1994; Macphail *et al.* 1998);
3. The inferred proxy relationship between dark coloured clay coatings, deposition of organic matter and phosphate in stock-trampled soils (Macphail and Cruise 2001; Macphail 2003); and
4. The analogue of Early-Middle Neolithic homogenised ash-rich deposits that contain allocthonous, micaceous, humic and phytolith-rich (wetland?) soil fragments at Arene Candide, Liguria, Italy, and which have been interpreted as stabling deposits that have been left to weather and become biologically worked *in situ* (namely 'homogeneous facies 4'; Macphail *et al.* 1997). Evidence of stratified 'layer cake' deposits of *in situ* stabling layers from over-wintering, probably burned in spring, appear to be absent, even in fragmentary form, from Ecsegfalva. (Such models are employed throughout southern France and northern Italy in cave sites: Binder *et al.* 1993; Sordoillet 1997; Boschian and Montagnari-Kokelji 2000; Binder and Maggi 2001; Macphail and Wattez, submitted.)

A major component of this model is the foddering of stock on tree-leaf hay, as still carried out in the Mediterranean and as also recorded in Swiss waterlogged Neolithic sites (Robinson and Rasmussen 1989; Rasmussen 1993; Halstead and Tierney 1998; Akeret and Rentzel 2001). This produces dung that is very much less phytolith-rich compared to that of animals fed on a grass/cereal-based diet, as could be the case at Ecsegfalva. In short, it is suggested that some of the ash deposits at Ecsegfalva could derive from stabling refuse that was first allowed to weather *in situ* (as in some contexts at Arene Candide) before burning. This possible practice, alongside burned midden waste, could reflect episodic clear-up activities.

Food and human coprolitic waste

Typical anthropogenic materials are concentrated by human occupation, and some can be common to all periods. At Ecsegfalva, shell and bone *(Figs 11.7–8)*, including fish bone, are probable dietary remains (see chapters 14 and 20). Some yellow to translucent coprolite fragments, sometimes with bone and cereal material, and which are autofluorescent under blue light (and which implies an calcium-phosphate 'apatite' mineralogy), are of probable human origin (Courty *et al.* 1989; Goldberg *et al.* in preparation). There can also be some similarities to dog coprolites, if the dogs have been scavenging human faecal material. The deposition of human waste into pits also produces coprolitic material and secondary phosphate features. There are also examples of phosphatised (mineral) soil at Ecsegfalva. These ('pale nodules') have been studied elsewhere by microprobe; despite this their exact origins are as yet unknown, but could come from cess pits ('cess pit nodules') or be fragments of soil that have become phosphatised by high concentrations of phosphate (Macphail 2000).

Trench 23B

Pits

Pit 390 was examined through an almost continuous sequence of 12 thin sections; from the top downwards: 5771, 10779, 10778 and 10777 (relative depths of 0.040–1.230 m).

At the base (*c.* 1.155–1.230 m: 385–384), inwash of subsoil and likely deposition under wet conditions, is recorded alongside such secondary effects as gleying (both Fe depletion and re-deposition – often with Mn) and $CaCO_3$ deposition. Only very small amounts of anthropogenic materials are included, and this can be totally homogenised with the subsoil through earthworm activity, for example (*c.* 1.035–1.155 m; 378). This obviously could imply a period of low intensity dumping. Above, this phase of biological reworking of the pit fill is followed by an ash dump of possible stabling refuse (SMT 5; *c.* 1.005–1.035 m: upper 378 and 375 lower) that remains preserved beneath another subsoil-dominated fill, which became earthworm-worked (*c.* 0.930–1.005 m: upper part of 373 lower).

Higher up (341–345, 347, 348, 384, 350–357, 369 and 373 upper), deposits are much more anthropogenic in character. These are basically ash-rich, with food (shell and fish bone and other bone) and human coprolitic material and related waste (SMT 5) *(Figs 11.7–8)*, and this is reflected in the high amounts of phosphate-P measured in these contexts *(Table 12.1)*. Details of the stratigraphic sequence are given in *Table 11.3*. Both soil micromorphology and microprobe demonstrate minor weathering and redeposition of $CaCO_3$, along with K, Mg and P *(Figs 11.5–6)*. Although the one major ash input is interpreted as burned stabling refuse, possible ashed monocotyledonous (cereal?) processing waste is present at 0.660–0.735 m (350–357).

As discussed above, in addition to dumping ashed midden waste and likely *in situ* dumping of some human waste material, a likely important component is burned stabling refuse that also includes soil fragments and dark coloured clay papules. These deposits have moderately well to well-preserved Neolithic analogues from France and Italy, where foddering was by tree leaf hay, e.g. Arene Candide (Macphail *et al.* 1997). Comparisons can also be made to later prehistoric sites in Wiltshire, UK. Examples include Potterne and Chisenbury where there was *in situ* midden formation associated with likely animal concentrations, and pit fills at Battlesbury that contained ashed cereal processing waste and likely burned dung (Macphail 2000; Macphail and Crowther 2002); Battlesbury also featured high phosphate concentrations and high magnetic susceptibility (χ_{max}) (see Crowther, chapter 12).

Another part of the upper fill of pit 390 was examined by sample 10785, where concentrated yellow material was prominent (see chapter 9). A micaceous silt and clay lump (348) had been inserted into a typical ash-rich upper pit fill (420). The clay lump could easily be raw material for some of the SMT D2 burned daub.

In Pit 393, sample 10783 (402–359) indicated a probable disturbed pit fill, one where fill from elsewhere had been redeposited. This is evidenced by fragments of textural pedofeatures (papules) being present, which would have had their origins in an earlier pit fill where soil slaking or alluvial flooding had occurred (see above). Even so, this deposition/redeposition had occurred under very wet conditions, producing dense calcitic occupation soil fills with a compact character, intercalations and clay coatings (pre-dating secondary) calcium carbonate and Fe-Mn features. The pit fill was often deposited in a wet state and/or under heavy rain.

The occupation deposits

Squares C12 and C15, North Extension

Sample 14647 (sampled from the surface of 464, in square C15) has a humic and fine charcoal-rich character and evidence of being totally biologically worked by plants and soil fauna. The moderate amounts of included anthropogenic materials (such as many burned daub fragments and rare bone and traces of allocthonous soil inclusions; SMT 2c) indicate that this is a relict human modified topsoil (perhaps formerly cultivated; see above), adjacent to domestic human occupation. Essentially then, this is topsoil with anthropogenic material trampled-in. Similar to sample 14779, sample 14631 (422/445/464) is much more anthropogenic in character. It shows less mixing of humic topsoil with lower horizons and higher amounts of included midden material (SMT 2c) *(Fig. 11.4)*, and this has resulted in a peak of phosphate-P at this level (*Fig. 12.5*, –35 cm). Trampling is possibly responsible for dusty clay coatings. Here, a humic, once-arable(?) topsoil is mixed with high amounts of (later) occupation/midden material.

Contexts 301–335

Sample 5769a (the uppermost part of a sample running down through 301–335) examined upper occupation deposits that have been homogenised by biological activity from recent surface soils, with the deposit (that includes likely coprolitic bone, a coprolitic nodule?, burned daub, and mixed anthropogenic soils) having undergone probable partial decalcification of a once-ash-rich matrix material (SMT 4a). The deposit has probably become thinner as a result. Below, sample 5679b (the upper part of 301–335) found less strongly weathered/decalcified occupation deposits rich in ashed remains, that may include possible cereal(?) ash (SMT 4b).

Main occupation deposit (327–397), CW Box

The soil micromorphology of the two lowermost thin sections of sample 10784 (relative depths of 145–270 mm) (10784b: 342–351; 10784c: 351–397) seems to suggest that they are aged, weathered, and compacted material of ashy occupation soil, human waste (and including stabling ash; SMT 5), with large amounts of included mixed subsoil material (SMT 1a). The sediment closely resembles that seen in the fill of Pit 390, in that subsoil clay is dominant, and unless there were pit features here not recognised in the field, may represent long weathered, redeposited deposit including material from pits elsewhere on the site. These deposits probably became strongly weathered and biologically homogenised before further ash-rich middening (SMT 5) in this area took place as shown in uppermost thin section 10784a (*c.* 70–145 mm) (327–342). This last material is clearly different in that it is markedly heterogeneous, and contains both subsoil and charcoal-rich occupation 'topsoil' material, as well as obvious ash, food and human faecal waste.

Context 400, North Box

In Square F11, sample 10781 (400 is in the main occupation deposit, North Box) found a well-sorted occupation soil, with very fine charcoal, intercalations and dusty clay coatings, and from the soil micromorphology can be considered a probable beaten mud floor surface (SMT 3) that may have been protected by shell dump (Gé *et al.* 1993; Macphail and Cruise 2001; Macphail *et al.* 2004). The nearby sample 10782 (Square D10) is more heterogeneous and appears to be another area of beaten mud floor, but because it was unprotected became mixed with some midden waste.

North Extension

Samples 14631 and 14647 from the burned daub-rich context 464 are humic, fine charcoal-rich dark topsoils, of putative arable origin (see above) but which have been enriched with high (14631) to moderate (14647) amounts of anthropogenic ash-rich midden material mainly in the uppermost 20 mm (SMT 2c). Burned daub (SMT D1 and D2) up to 35 mm in size is present (see *Figs 11.1–3*). Deeper sampling below burned daub concentrations (in the area of context 458) with monolith 14522 found a buried soil sequence (relative depths 40–325 mm: 482/483). The lowermost thin section (250–325 mm: 14522b2) contained little anthropogenic material apart from fine charcoal and could be an upper subsoil/topsoil transition (485) of a landscape kept open by fire (SMTs 2b and 1d). Above, (150–250 mm: 14522b) a supposed humic and charcoal-rich arable topsoil contains increasing amounts of (later) mixed-in burned daub-rich anthropogenic inclusions (484). The uppermost buried occupation layer (482/483) is rich in occupation debris and juxtaposed soil materials. It has a porosity and textural pedofeatures indicative of mixing and slaking (closed vughs, interactions and dusty clay coatings) that could suggest the presence of a probable mixed beaten floor/occupation deposit. These may have formed under poorly sheltered (roofed) conditions where the floor was not completely protected from the weather, with the added possibility that general trampling by animals contributed to mixing (SMT 3). Experimental floor data from various Pimperne Houses at Butser Ancient Farm, Hampshire developed from 1975 to 1990 (1st Demonstration Area) and during 1994 (2nd Demonstration Area) (Macphail and Cruise 2001; Macphail *et al.* 2004), and archaeological analogues from prehistoric, Roman and Medieval sites, contribute to the interpretations suggested above (Courty *et al.* 1989; Cammas 1994; Courty *et al.* 1994; Matthews *et al.* 1997).

West Extension

Context 469 (Square L10) was examined using sample 14590 and only small amounts of anthropogenic material were found here, in a soil of putative arable topsoil origin (SMT 2b). Here, 'bird's foot' planar voids are indicative of possible cultivation under very wet conditions. A similar porosity pattern is found in sample 14758 [452/600] where again amounts of included anthropogenic material are low, and where the soil could have an arable history, a suggestion reinforced by an early phase of textural pedofeature formation.

Sample 14779 (486–493) has a similar supposed arable soil origin, but here large amounts of burned structural and occupation debris have become included.

Trench 23A

1412 sequence (5 thin sections) (Table 11.3)

This represents the fill of the pit or scoop 136 (contexts 125, 128 and 129: see chapter 9), that is composed of anthropogenic deposits and deep subsoil/natural silty clays that are rich in mica, and contain shell fragments and pisolitic iron and manganese nodules (Fe/Mn) (SMT1a).

The lowermost sample (M1412c) is mainly composed of deep calcareous silty clay, but also includes large amounts of burned clay daub in this specific sample, although in general Trench 23A contained less burned daub than Trench 23B (see chapter 9). Small amounts of poorly mixed charcoal- and phytolith-rich Poaceae ash residues, including rare patches of calcite ash (SMT2), are also present. Charcoal and rare examples of likely human coprolitic material and bone are also present. Upwards, the fills contain varying proportions of subsoil silty clay and SMT1b: subsoil homogenised with charred and amorphous organic matter and phytoliths (derived from inputs of SMT2). Ubiquitous constituents are generally high amounts of burned clay daub and trace quantities of likely cess and bone. Also rarely present are patches of calcitic ash and possible ashed herbivore coprolites, but most materials have become homogenised. The deposits were commonly rooted, with the lowermost layers being affected by secondary calcium carbonate (micritic) impregnation, whereas higher up, this phenomenon was absent and diffuse iron and manganese impregnation becomes more common. In the uppermost two samples (M1412a1 and M1412a2), intercalations and textural features associated with vesicles become more common.

Phases of dumping are followed by localised biological working of these deposits, prior to the next phase of dumping. This may imply periodic occupation. Also, apart from Poaceae ash waste being dumped, some food and cess were also deposited. Upwards the deposits became more carbonate free, from probable surface soil leaching. In addition, periodic wetness and poor drainage (flooding?/rain) led to slaking, slumping and the formation of gley soil mottling.

1240

Three thin sections, 1240a–1240c, examined another part of Trench 23A, below the AVK burial and into contexts 108, 110 and 113 (thus into the upper part of the deposits and scoops underlying the burial itself). Here, the infilling is heterogeneous, with frequent to dominant amounts of anthropogenic material being poorly mixed with subsoil. The lower part has been influenced by ubiquitous gleying and secondary carbonate formation. As in 1412 there are inputs of burned material, including burned daub, charcoal, ashes and phytoliths, possibly reflecting dumps of cereal processing remains (see chapter 24). The fill has also received human waste. As in Trench 23B, dumping disturbance, flooding and/or rain have produced clay inwash.

1241

Another sample (1241) from the lowermost part of the south-west corner of Trench 23A (through contexts 103, 104, 109 and 111), is a good example of only very slightly contaminated natural alluvial loess, which is calcareous and contains natural shell. It is even possible that the pale scat present is itself of alluvial origin (cf. mink scat at the Lower Palaeolithic site of Boxgrove, Sussex, UK: Roberts and Parfitt 1999). The main effect of the overlying quarry is thus contamination by small amounts of charred material and dusty clay inwash.

Trench 23C, Squares XY 14–15

Sample 9381 examined the upper contexts 512–514, and was complemented by samples 9641 and 9644 from the lower part of the shallow pit or scoop (see chapter 9). Finally, sample 9674 was taken from above the child's skull (now shown by radiocarbon dating to be of first millennium AD date) in 542–543.

The fill of 512–514 is gleyed with small amounts of secondary carbonate deposition. Only small amounts of anthropogenic materials are present in this slaked and mixed deposit (intercalations and dusty clay infills), which shows no very strong difference between the lower and upper fills. The soil micromorphological characteristics may reflect a shallow feature infilling through silting dominated by local soil, but often under wet conditions, and with mixing and slaking possibly induced by trampling. The anthropogenic material includes human waste and a phosphatised 'pale' nodule (see above). The shallow pit fill is essentially a midden fill that upwards, has been more strongly influenced by general weathering processes. There have been inputs of charcoal, ash, bone, burned daub, shell and human faecal waste. The ashes have several origins, including some likely cereal processing material, wood ash – some of possible stabling refuse origin (see above). It can be noted that sample 9644, from the base of the pit, is a two-phase ash fill that first underwent a likely period of weathering and mixing with the natural subsoil, prior to a second phase of dumping which seems to have taken place under wet or soon flooded conditions which led to the formation of intercalations and clay deposition. Upwards, ash middening continues with for example fish bone and more evidence of possible ashed stabling refuse being dumped. All the way up there is evidence of the fill being affected by wetting and clay inwash, again suggestive of the influence of local flooding, as well as the poor drainage characteristics of the substrate. Some caution needs to be exercised here, however, as the amounts of inwashed clay seem to increase upwards in the 9641 sample sequence, which may suggest that these clay inwash pedofeatures post-date the site and are of a more recent flooding event. After all, the secondary carbonate pedofeatures seem to post-date these clay inwash features. Both may therefore be post-depositional in origin, with more recent changes to the hydrology of the site being recorded (see chapters 4–5). Although there is no doubt that this area (Trench 23A) was wet at times during the Early Neolithic, actual flooding and alluviation may well be more recent. As an analogue, traces (in the form of distinctive yellowish brown clay coatings) of Saxon and medieval alluvium at Raunds, Northamptonshire were found in barrow-buried Bronze Age soils as deep as 1.80 m below the present ground surface (Macphail forthcoming).

Sample 9674 seems to show that the fill above the child's skull is of a similar ash-rich midden deposit that could well contain ashed stabling refuse, but as the child's skull dates to a much later period, the overlying material may well be redeposited. It still seems, however, that apparent site wetness and flooding, perhaps post-depositional in date, have been recorded here.

Discussion

Flooding and alluviation

Secondary clay inwash is recorded in pits located in Trench 23A and especially in Trench 23C. It is difficult to exactly explain and date this phenomenon, although it seems to have occurred prior to some major secondary carbonate features. One explanation that can be attempted is that it is the effect of recent ploughing across the whole site, but the lower deposits in Trench 23A are essentially unaffected. Alternatively, some clay inwash may have occurred through very wet silting in pits, and the effect of rainfall on dumped soil; and undoubtedly this has contributed to some of the clay inwash features (see above and *Table 11.3* for details). On the other hand, alluviation that may well post-date the first millennium AD, may be responsible for fine clay wash into 'open' ashy deposits, especially in the relatively lower ground of Trench 23C.

Old Ground Surface patterns

It appears that in the North and West extensions of Trench 23B a supposed arable soil (SMT 1d/2b/2a) preceded a structure that appears to have had a trampled floor (SMT 3). Later destruction and midden spreads (SMT 2c) mainly affected the North Extension, and the edge of the West Extension, which appears to be consistent with the pattern of concentrations of P and magnetic susceptibility (see *Figs 12.12–13*). Thus, a soil landscape kept open by fire and with a history of possible arable use, was intensively occupied especially in the North Extension and edge of the West Extension. This occupation appears to have been both domestic (daub structure construction, food preparation, defecation) and agricultural (herding) in character, and although pit fills such as 390 show much waste material was dumped, this occupation area became markedly effected by the accumulation of anthropogenic materials, as independently recorded by P and magnetic susceptibility analyses (see chapter 12). The structure(s) were apparently for domestic use, as interpreted from the identification of beaten floors: and not employed to keep animals (Macphail and Goldberg 1995; Macphail and Cruise 2001; Macphail *et al.* 2004). It also seems clear that materials produced by stock herding (waste fodder and bedding, and dung itself) were disposed of by burning: hence the very large amounts of ash deposits across the site and in pits.

This was a common practice in the Neolithic, and has for example been ascribed to the need to 'clean' a site of animal parasites (Macphail *et al.* 1997). Although the soil micromorphology cannot identify any seasonal use of the site, it has shown that the site/or parts of the site were used intermittently. This is demonstrated by anthropogenic materials being found at various depths in the buried soil, which is very unlikely to reflect a record of a single occupation. Equally, sub-aerially weathered ash is included in the soil. Lastly, the pit fills often show 'weathering' and even meteorological events, between dumping episodes.

Conclusions

Soil micromorphology provides detailed insights into the stratigraphy at Ecsegfalva, by identifying both pedological and anthropogenic features and inclusions not obvious to the naked eye. It thus makes an invaluable contribution to the environmental and cultural understanding of the site.

Together with the other disciplines employed at the site, soil micromorphology was able to recognise:

1. A natural fine textured alluvial gley soil variously affected by groundwater and the movement of calcium carbonate, and probably later on its history, alluvial flooding of low ground.
2. An Early Neolithic soil that pre-dates occupation deposits, and which appears to have been influenced by maintenance of an open landscape by fire, and was possibly arable in character.
3. An accumulation of occupation deposits that stem from: the construction of reed(?)-tempered daub-walled structures (for domestic use) employing local soils and geology for the daub; the manufacture of a fine daub (without plant tempering) that on burning produced a pale edge ('plaster edge') and which may have been used for oven construction – the pale edge possibly reflecting a concentration of potassium (K) and fine organic matter – and floor or inner lining of the oven(?); domestic debris (charcoal, pottery, burned daub, food, food processing and faecal waste – including burned cereal-processing waste rich in articulated phytoliths, bone, burned bone, fish bone and phosphate-rich coprolitic material); and finally the burned remains of stock herding (ashed remains of animal fodder, bedding, dung, and 'soil' features of possible animal trampling, seen in the dark clay coatings and allocthonous soil clasts).
4. Various uses of space: a focus/foci of occupation where middening deposits are concentrated, and out from which trampling/and or dumping activity spread debris across the site.
5. And finally evidence of episodic occupation of the site – biological working and weathering of deposits between occupations of the land surface/dumping episodes in pits/meteorological events (rainstorms).

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Chapter 12

CHEMICAL AND MAGNETIC PROPERTIES OF SOILS AND PIT FILLS

John Crowther

Introduction

Analysis was undertaken on bulk samples of modern soils, buried occupation deposits, pit fills and a range of other materials (e.g. burnt daub: from site and from experimental burning) from Trenches 23A, 23B and 23C at Ecsegfalva in the hope of gaining additional insight into the origins of certain contexts and the nature and spatial pattern of human activity. Details of the samples and descriptions of the contexts from which they were taken are presented in *Appendix 12.1.* Some of the samples analysed were taken close to soil monoliths that were taken for thin section analysis by Richard Macphail. The present report should therefore be read in conjunction with his soil micromorphology report (chapter 11). The range of analysis undertaken varied according to sample type. Attention focused specifically upon phosphate and magnetic properties, both of which are widely used in archaeological site investigation.

Phosphate

Phosphates are present in all organic material (plant tissue, excreta, bone, etc.). As they are released by organic decomposition processes they tend to form insoluble compounds and thus become 'fixed' within the mineral fraction of soils. Many forms of human activity lead to phosphate enrichment and, under favourable conditions, this may remain detectable in soils and sediments over timescales of 10^2–10^3 years (see reviews of phosphate analysis by Bethell and Máté 1989; Crowther 1997; Heron 2001). Good retention of phosphate would be anticipated in view of the alkaline soil conditions at Ecsegfalva. In order to establish the form of the phosphates present, *phosphate-*P_i (total inorganic phosphate) and *phosphate-*P_o (total organic phosphate) were determined separately for some of the samples. These were summed to give *phosphate-P* (total phosphate), and the ratios *phosphate-*P_i*:P* and *phosphate-*P_o*:P* (expressed as percentages) were calculated. For the remaining samples on which phosphate analysis was undertaken, only phosphate-P was determined.

Magnetic properties

χ (low-frequency mass-specific magnetic susceptibility) in soils largely reflects the presence of magnetic forms of iron oxide (e.g. maghaemite), this being dependent upon the occurrence of iron and of alternating reduction-oxidation conditions that favour the formation of magnetic minerals. Enhancement can result from microbial activity in topsoils, but is particularly associated with burning (see reviews by Scollar *et al.* 1990; Clark 1996). χ_{max} is a measure of maximum potential magnetic susceptibility, determined by subjecting a sample to optimum conditions for susceptibility enhancement in the laboratory. In general it will tend to reflect the overall iron concentration. χ_{conv} (fractional conversion), which is expressed as a percentage, is a measure of the extent to which the potential susceptibility has been achieved in the original sample, viz: $(\chi/\chi_{max}) \times 100.0$ (Tite 1972; Scollar *et al.* 1990). In many respects this is a better indicator of magnetic susceptibility enhancement than χ, particularly in cases where soils have widely differing χ_{max} values (Crowther and Barker 1995; Crowther 2003).

In addition, determinations were made of *particle size*; *LOI* (loss-on-ignition), which provides an estimate of the organic matter content; *pH*, which gives an indication of the extent to which the soils and fills have been affected by the alkalisation processes reported previously (Molnár and Sümegi, chapter 4; Sümegi and Molnár, chapter 5); and *carbonate* concentration. The presence of calcium and magnesium carbonate in such soils and sediments could be derived from a variety of sources (limestone bedrock, secondary precipitation from Ca-rich soil waters, shell material, ash, etc.). Hopefully, some indication of the source(s) of carbonates in the present samples will gained from the micromorphological evidence.

Methods

Analysis was undertaken on the fine earth fraction (i.e. < 2 mm) of the soils and sediments. Particle size (by pipette method), pH (1:2.5, water) and carbonate (by calcimeter) were determined using the methods presented by Avery and Bascomb (1974). LOI was determined by ignition at 375°C for 16 hours (Ball 1964). Previous experimental studies have shown that there is no significant breakdown of carbonates at this temperature. For samples analysed from the 2000 excavation, phosphate-P_i and phosphate-P_o were determined using a two-stage adaptation of the procedure developed by Dick and Tabatabai (1977) in which the phosphate concentration of a sample is measured first without oxidation of organic matter, using HCl as the extractant (P_i); and then on the residue following alkaline oxidation with NaOBr (P_o). For the remaining samples, phosphate-P was determined following oxidation with NaOBr. A Bartington MS1 meter was used for magnetic susceptibility measurements. χ_{max} was achieved by heating samples at 650°C in reducing, followed by oxidising conditions. The method used broadly follows that of Tite and Mullins (1971), except that household flour was mixed with the soils and lids placed on the crucibles to create the reducing environment (after Graham and Scollar 1976; Crowther and Barker 1995).

Standard statistical methods have been employed in the analysis of the results: Pearson's product-moment correlation and analysis of variance. In all cases statistical significance was assessed at the 95% confidence level (i.e. $\alpha = 0.05$).

Results and discussion

Details of the samples analysed are presented in *Appendix 12.1.* Apart from the analytical data for the spatial survey across Trench 23B, which are presented in *Appendix 12.2*, the data on soil chemistry, magnetic properties and particle size are presented in *Tables 12.1–3*, respectively.

Table 12.1. Chemical properties of samples

Sample/context (depth, cm)	LOI (%)	pH (1:2.5, water)	Carbon-ate (%)	Phosphate P_i (mg g^{-1})	Phosphate P_o (mg g^{-1})	Phosphate P (mg g^{-1})	Phosphate P_i:P (%)	Phosphate P_o:P (%)
TRENCH 23A								
Pits/scoops, Column 1241: extending through occupation deposits into underlying subsoil								
1241a (0–10)	4.03	8.9	7.07	5.02	0.602	5.62	89.3	10.7
1241b (10–20)	3.88	8.9	7.94	4.57	0.640	5.21	87.7	12.3
1241c (20–30)	3.93	8.8	6.48	4.72	0.631	5.35	88.2	11.8
1241d (30–45)	2.83	8.8	11.1	2.67	0.396	3.07	87.0	13.0
1241e (45–56)	3.41	8.8	5.24	2.57	0.506	3.08	83.4	16.6
1241f (56+)	2.47	9.1	7.64	1.41	0.369	1.78	79.2	20.8
TRENCH 23B								
Column 14631: extending through modern soil to below occupation deposits in N extension								
14716/422 (0–5)	6.96	7.9	1.45			4.39		
14717/422 (5–10)	7.44	7.7	0.843			4.96		
14718/422 (10–15)	7.76	7.2	0.333			3.74		
14719/422 (15–20)	7.03	6.3	0.149			3.97		
14720/422 (20–25)	6.76	5.8	0.129			3.77		
14721/422 (25–30)	6.55	6.6	0.195			5.66		
14722/445 (30–35)	5.51	7.7	1.89			6.67		
14723/464 (35–40)	4.90	8.0	6.10			5.36		
14724/488 (40–45)	4.53	8.1	11.0			4.87		
14725/489 (45–50)	3.99	8.2	13.2			4.76		
14726/490 (50–55)	3.72	8.3	11.5			4.24		
14727/490 (55–60)	3.44	8.3	14.0			3.27		
14728/491 (60–65)	3.42	8.4	13.4			3.27		
14729/492 (65–70)	3.13	8.4	10.9			3.49		
Column 10784: midden material over disturbed natural								
10784/327 (7–11)	4.24	8.5	19.3	5.06	0.985	6.05	83.6	16.4
10784/342 (11–16)	5.56	8.6	23.9	5.47	1.93	7.40	73.9	26.1
10784/351 (16–22)	3.62	8.7	11.1	3.39	0.688	4.08	83.1	16.9
10784/397 (22–27)	3.45	8.8	7.73	2.19	0.399	2.59	84.6	15.4
Sections through occupation deposits:								
Square L10								
14708 (0–5)	4.36	8.3	1.99			3.00		
14708a (5–10)	4.15	8.4	3.20			2.75		
Square C15								
14711 (0–5)	5.37	7.9	3.05			12.2		
14712 (5–10)	4.88	8.0	4.03			8.06		
Samples of specific materials:								
Burnt daub								
10780/305	1.54	8.7	3.21	1.58	0.527	2.11	74.9	25.1
Yellow silt								
14328	2.85	8.5	8.73			1.12		

Table 12.1. Continued

Sample/context (depth, cm)	LOI (%)	pH (1:2.5, water)	Carbon-ate (%)	Phosphate P_i (mg g^{-1})	Phosphate P_o (mg g^{-1})	Phosphate P (mg g^{-1})	Phosphate P_i:P (%)	Phosphate P_o:P (%)
Ash sample								
14372/474	1.79	8.4	24.5			5.12		
Samples from 1 m grid across occupation deposits (see also *Appendix 12.2* and *Table 12.5*)								
10781/400F11 (0–8)	3.90	8.8	6.24	1.57	0.330	1.90	82.6	17.4
10782/400D10 (0–8)	4.12	8.7	10.7	3.35	0.619	3.97	84.4	15.6
Pit 390								
5771/341	4.12	8.5	27.0	1.58	0.527	8.47	89.1	10.9
5771/345	4.10	8.5	36.0	9.59	1.07	10.7	89.6	10.4
5771/347	3.19	8.4	40.9	5.78	1.18	6.96	83.0	17.0
5771/348	3.22	8.5	41.2	7.21	0.856	8.07	89.3	10.7
10779/350	4.04	8.6	14.8	5.76	0.542	6.30	91.4	8.6
10779/357	4.38	8.5	14.3	4.53	0.673	5.20	87.1	12.9
10779/369	3.68	8.7	27.2	5.77	0.708	6.48	89.0	11.0
10778/373 upper	3.70	8.6	8.75	2.91	0.437	3.35	86.9	13.1
10778/373 lower	3.38	8.6	1.87	1.03	0.292	1.32	78.0	22.0
10777/378	3.14	8.6	6.18	1.60	0.374	1.97	81.2	18.8
10785/350	3.10	8.6	35.0	5.82	0.668	6.49	89.7	10.3
10785/420	1.98	8.6	10.5	1.95	0.340	2.29	85.2	14.8
Pit 393: Base of topsoil through layered occupation deposits								
10783/topsoil (0–10)	5.11	8.5	15.2	9.59	0.961	10.6	90.5	9.5
10783/402 (10–50)	4.15	8.5	29.9	8.05	0.993	9.04	89.0	11.0
10783/359 (50–100)	3.45	8.7	35.3	8.35	0.897	9.25	90.3	9.7
TRENCH 23C								
Pit in XY14–15 (2 columns):								
Column 9381								
9381/511	3.78	9.2	7.15	7.13	0.699	7.83	91.1	8.9
9381/512	3.44	9.1	4.53	4.76	0.471	5.23	91.0	9.0
9381/514	3.01	9.0	3.96	3.77	0.445	4.22	89.3	10.7
Column 9641								
9657/524	3.46	8.9	34.6			11.1		
9658/526	3.23	8.9	39.8			9.98		
9659/528	3.04	8.9	39.9			9.44		
9660/530	2.63	8.8	54.0			14.1		
9661/531	3.54	8.6	25.3			7.83		
9662/532	3.51	8.5	7.29			3.76		

Table 12.2. Magnetic properties of samples

Sample/context (depth, cm)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)
TRENCH 23A			
Pits/scoops, Column 1241: extending through occupation deposits into underlying subsoil			
1241a (0–10)	65.8	1080	6.09
1241b (10–20)	65.5	1240	5.28
1241c (20–30)	66.3	1040	6.38
1241d (30–45)	98.0	1130	8.67
1241e (45–56)	48.3	1200	4.03
1241f (56+)	17.3	1440	1.20
TRENCH 23B			
Column 14631: extending through modern soil to below occupation deposits in N extension			
14716/422 (0–5)	154	935	16.5
14717/422 (5–10)	140	934	15.0
14718/422 (10–15)	128	864	14.8
14719/422 (15–20)	142	862	16.5
14720/422 (20–25)	158	876	18.0
14721/422 (25–30)	153	872	17.5
14722/445 (30–35)	196	921	21.3
14723/464 (35–40)	261	957	27.3
14724/488 (40–45)	245	904	27.1
14725/489 (45–50)	248	922	26.9
14726/490 (50–55)	222	924	24.0
14727/490 (55–60)	224	967	23.2
14728/491 (60–65)	224	985	22.7
14729/492 (65–70)	310	1050	29.6
Column 10784: midden material over disturbed natural			
10784/327 (7–11)	103	674	15.3
10784/342 (11–16)	92.0	666	13.8
10784/351 (16–22)	61.2	723	8.46
10784/397 (22–27)	64.1	903	7.10
Sections through occupation deposits:			
Square L10			
14708 (depth 0–5)	46.4	909	5.10
14708a (5–10)	43.1	889	4.85
Square C15			
14711 (0–5)	197	1040	18.9
14712 (5–10)	213	1040	20.5
Samples of specific materials:			
Burnt daub			
10780/305	717	1490	48.1
11884a	1770	2570	68.9
11884b	1310	1920	68.2

Table 12.2. Continued

Sample/context (depth, cm)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)
11884c	1100	1870	58.8
11884d	1900	2670	71.2
11884e	1170	1750	66.9
11884f	1840	2560	71.9
11884g	1030	1220	84.4
11884h	654	1110	58.9
14323a	231	477	48.4
14323b	162	357	45.4
14323c	540	682	79.2
14323d	1050	1210	86.8
14325	1120	1640	68.3
'Plaster'			
14323e	1620	1840	88.0
14323f	1230	1370	89.8
14323g	1710	1800	95.0
14323h	2070	2180	95.0
Sherd samples			
14326a	392	802	48.9
14326b	631	898	70.3
14326c	567	917	61.8
14326d	340	629	54.1
14327a	253	396	63.9
14327b	119	247	48.2
14327c	175	349	50.1
Yellow silt			
14328	14.6	1460	1.00
Ash-rich deposit			
14372/474	633	903	70.1
Soils in close proximity to burnt daub:			
Main burnt daub 458: surface samples to left			
14632/479 (distance 0–2.5 cm)	94.7	885	10.7
14633/479 (2.5–5.0)	77.8	906	8.59
14634/480 (5.0–7.5)	70.5	873	8.08
14635/480 (7.5–10.0)	62.7	899	6.97
Main burnt daub 458: surface samples to right			
14658/479 (distance 0–2.5 cm)	303	1170	25.9
14659/479 (2.5–5.0)	189	997	19.0
14660/480 (5.0–7.5)	204	1010	20.2
14661/480 (7.5–10.0)	169	966	17.5
Beneath main burnt daub 458: vertical column			
14687/479 (depth 0–2.5 cm)	160	1030	15.5
14688/479 (2.5–5.0)	191	1060	18.0
14689/480 (5.0–7.5)	175	1080	16.2

Table 12.2. Continued

Sample/context (depth, cm)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)
14690/480 (7.5–10.0)	147	1050	14.0
14701/480 (10.0–12.5)	176	966	18.2
14702/482 (12.5–15.0)	162	969	16.7
14703/483 (15.0–17.5)	99.4	1020	9.75
14704/485 (17.5–20.0)	47.3	1200	3.94
Small burnt daub patch: surface samples to left			
14771 (distance 0–5 cm)	30.2	1130	2.67
14772 (5–10 cm)	29.1	1200	2.43
Small burnt daub patch: surface samples to right			
14773 (distance 0–5 cm)	42.7	1210	3.53
14774 (5–10 cm)	30.2	1290	2.34
Under burnt daub 'wall' in W extension			
14788/493	222	1040	21.3
Samples from 1 m grid across occupation deposits (see also *Appendix 12.2* and *Table 12.5*)			
10781/400F11 (0–80)	44.4	787	5.64
10782/400D10 (0–80)	127	783	16.2
Pit 390			
5771/341	79.6	614	13.0
5771/345	135	555	24.3
5771/347	158	575	27.5
5771/348	128	490	26.1
10779/350	44.9	677	6.63
10779/357	121	761	15.9
10779/369	135	682	19.8
10778/373 upper	73.0	1000	7.30
10778/373 lower	27.1	1120	2.42
10777/378	23.2	1380	1.68
10785/350	116	662	17.5
10785/420	29.5	1660	1.78
Pit 393: Base of topsoil through layered occupation deposits			
10783/topsoil (0–10)	109	563	19.4
10783/402 (10–50)	116	449	25.8
10783/359 (50–100)	203	625	32.5
TRENCH 23C			
Pit in XY14–15 (2 columns):			
Column 9381			
9381/511	85.2	708	12.0
9381/512	39.5	965	4.09
9381/514	28.8	1170	2.46

Table 12.2. Continued

Sample/context (depth, cm)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)
Column 9641			
9657/524	95.1	352	27.0
9658/526	122	371	32.9
9659/528	133	421	31.6
9660/530	105	293	35.8
9661/531	48.8	582	8.38
9662/532	34.2	1020	3.35
Experimental burning			
ExB1	68.8	1230	5.59
ExB2	71.8	1220	5.88
ExB3	298	1220	24.4

Table 12.3. Particle size distribution of selected samples

Sample/context (depth, cm)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
TRENCH 23B					
Column through modern soil to below occupation deposits					
14716/422 (0–5 cm)					
14717/422 (5–10)	1.4	0.7	1.5	59.5	36.9
14718/422 (10–10)					
14719/422 (15–20)					
14720/422 (20–25)	2.1	0.5	2.0	50.5	44.9
14721/422 (25–30)					
14722/445 (30–35)	3.8	1.7	2.5	54.5	37.5
14723/464 (35–40)	7.9	2.7	3.4	52.6	33.4
14724/488 (40–45)	9.1	2.8	4.5	52.6	31.0
14725/489 (45–50)	10.8	3.3	4.7	50.0	31.2
14726/490 (50–55)					
14727/490 (55–60)	11.0	4.3	6.3	49.3	29.1
14728/491 (60–65)	9.7	5.2	7.0	49.9	28.2
14729/492 (65–70)	17.6	7.5	7.6	46.5	20.8
Samples of specific materials					
Yellow loess					
14328	2.8	1.4	2.1	52.2	41.5
Samples from 1 m grid across occupation deposits					
13900	0.7	0.9	2.3	46.7	49.4
13908	0.8	1.0	2.2	47.5	48.5
13940	3.6	1.7	2.9	56.0	35.8
13958	0.5	0.2	0.9	39.8	58.6
13998	4.8	2.0	2.8	47.2	43.2
14010	1.8	1.3	2.7	47.1	47.1
14042	1.2	1.4	2.8	45.5	49.1
14054	3.8	1.9	2.9	45.3	46.1

Vertical sequences through present-day soils and occupation deposits into underlying natural

Column 14631 (Trench 23B): modern soil, occupation deposits and natural

This sample column, which is taken to be representative of the soils at Site 23, comprises a complete sequence of soils, sampled in contiguous 5 cm slices, extending from the modern ground surface and topsoil, through the underlying occupation deposits, and into the underlying natural. The soils are developed on fine-textured alluvial (levée) deposits, typically comprising < 15.0% sand, 45–55% silt and 30–40% clay *(Table 12.3)*. The high silt content may be partly attributable to loess deposition, either directly on the flood plain or on slopes within the drainage basin. Within a deeper section of the flood plain deposits in Trench 23B, a layer of yellow silt was identified (sample 14328). This contained 52.2% silt and 41.5% clay. In soil column 14631 there is a marked increase in sand content down the profile *(Fig. 12.1)*. The lowermost sample (at 65–70 cm) contains 32.7% sand, of which more than half is coarse sand. Bioturbation within the upper part of the soil may be a contributory factor, with fines being increasingly concentrated within the modern topsoil (0–30 cm). The topsoil has a moderate organic matter concentration (LOI range, 6.55–7.76%). Below 30 cm LOI diminishes progressively to 3.13% at 65–70 cm. The absence of a secondary peak in the LOI data within the sequence (as might be associated with an old ground surface i.e. a distinct surface that was buried by later deposits) suggests that the occupation deposits built up progressively

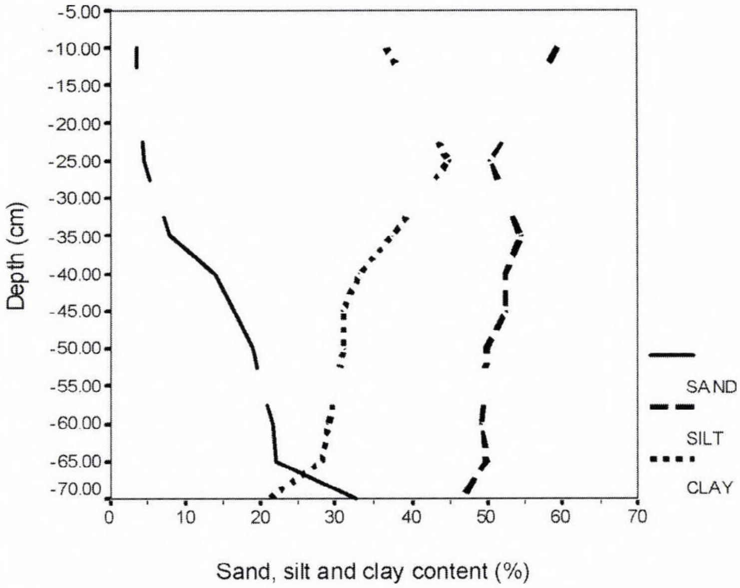


Fig. 12.1. Column 14631. Variations in sand, silt and clay content (%) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

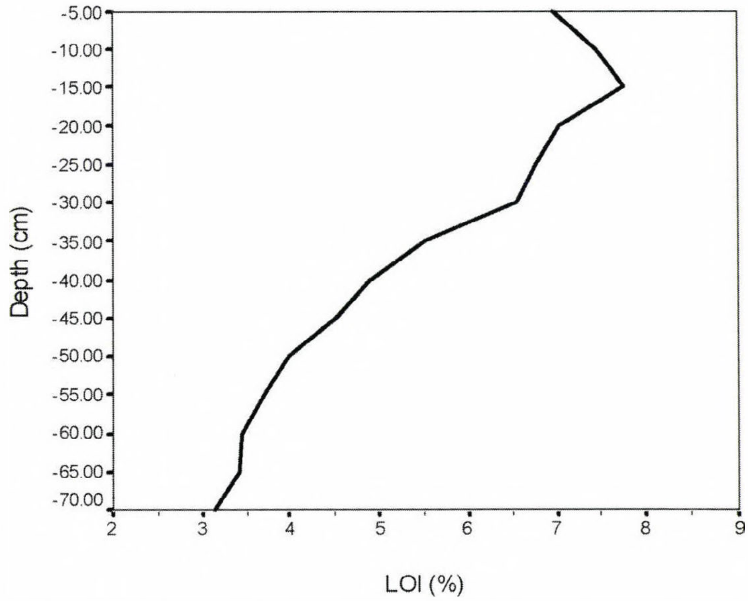


Fig. 12.2. Column 14631. Variations in LOI (%) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

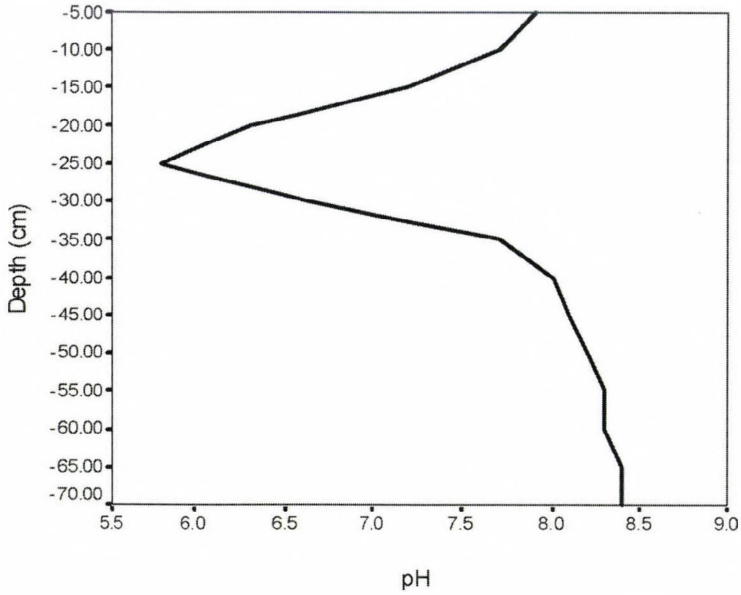


Fig. 12.3. Column 14631. Variations in pH in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

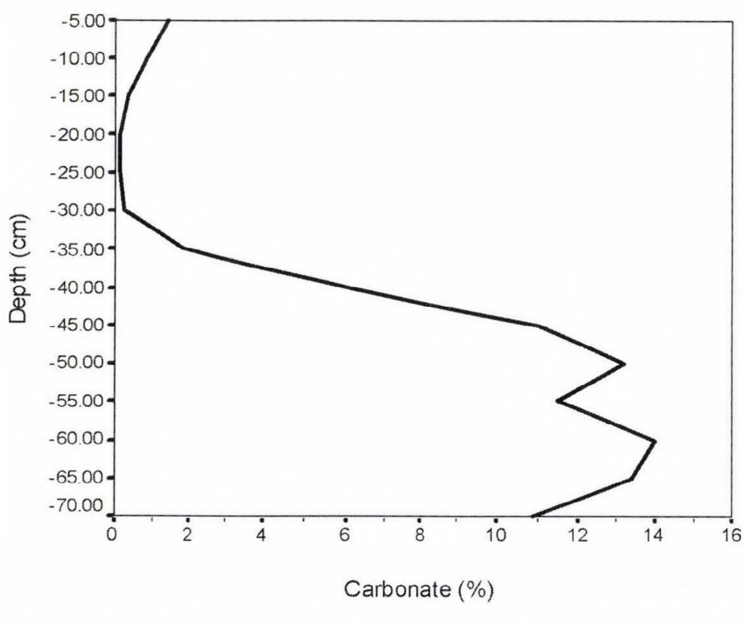


Fig. 12.4. Column 14631. Variations in carbonate concentration (%) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

over time without a significant hiatus in accumulation. The soil exhibits marked variations in pH and carbonate content down through the profile *(Figs 12.3–4)*. As would be anticipated, the two properties are strongly correlated (Pearson's product-moment correlation coefficient (r) = 0.779, p = 0.001). There is clear reduction in pH (from 7.9 to 5.8) and carbonate (from 1.45 to 0.129%) down through the topsoil, which presumably reflects a degree of salt accumulation at the surface as a result surface evaporation, in an otherwise leached topsoil. Below 30 cm, however, there is a marked increase in pH (maximum 8.4) and carbonate content (14.0%). Interestingly, the sample of 'yellow silt', taken at greater depth within the flood-plain deposits, was found to contain only 8.73% carbonate. This perhaps suggests that the higher carbonate concentrations recorded in the lower part of the soil column are related to salt accumulation at the top of the watertable (and see Sümegi *et al.*, this volume).

The modern topsoil contains a moderately high concentration of phosphate-P *(Fig. 12.5)*. As is generally the case (because of nutrient cycling via the vegetation system), the highest concentrations occur in the topmost samples (maximum, 4.96 mg g^{-1} at 5–10 cm). The most striking feature of the phosphate data, however, is the very marked peak in concentration recorded between 25 and 55 cm (maximum, 6.67 mg g^{-1} at 30–35 cm), which presumably reflects enrichment within the occupation deposits. It should be noted that phosphate-P concentrations in excess of 5.00 mg g^{-1} are rarely encountered in archaeological soils and sediments, and this would seem to confirm the 'richness' of the occupation layers which has been noted from field evidence and the results of other specialist investigations (chapter 9). Below 55 cm the phosphate-P concentration falls to less than 3.50 mg g^{-1} (minimum, 3.27 mg g^{-1} at 55–65 cm).

As outlined in the introduction, caution needs to be exercised when interpreting χ data *(Fig. 12.6)*, because of possible variations in the potential susceptibility (χ_{max}) arising primarily from variations in Fe content. In this case, χ_{max} generally increases down the profile *(Fig. 12.7)*, from as low as 862 x 10^{-8} SI in the top 20 cm of the soil to 1050 x 10^{-8} SI at 65–70 cm. The variability in χ_{max} is, however, relatively small compared with that of χ (range, 128–310 x 10^{-8} SI) and as a consequence there is a very strong underlying relationship between χ and χ_{conv} ($r = 0.984$, $p < 0.001$; cf. *Figs 12.6* and *12.8*). In these circumstances, χ data can be interpreted with some measure of confidence as reflecting the degree of enhancement that has taken place. It should also be noted that the χ_{conv} values below 30 cm are all in excess of 20%, which are high values, indicative of enhancement. The results show a peak in χ at between 30 and 55 cm (maximum, 261 x 10^{-8} SI), which correlates closely with the phosphate-P curve. The further increase recorded at the base of the profile is probably attributable to deposition of magnetic forms of Fe associated with watertable fluctuations, though further investigations would be needed to confirm this. It should be noted that the yellow silt displays a very low χ (14.6 x 10^{-8} SI) and χ_{conv} (1.00%).

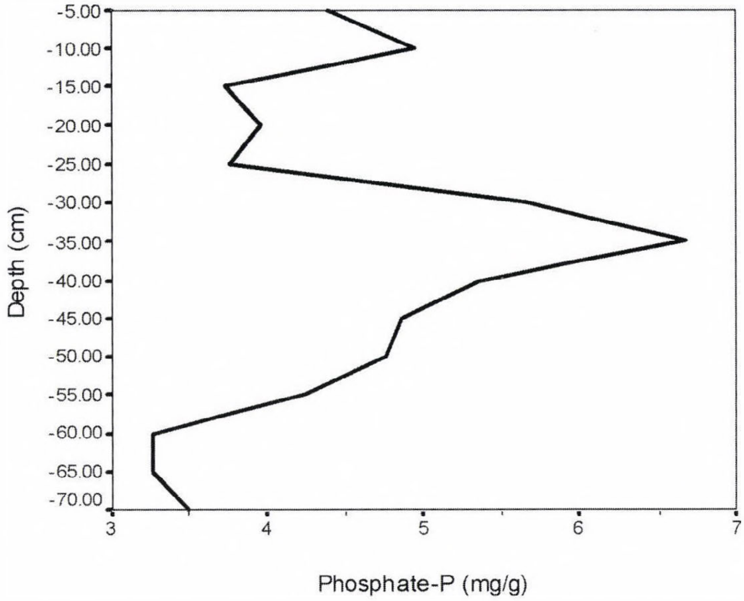


Fig. 12.5. Column 14631. Variations in phosphate-P concentration (mg g^{-1}) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

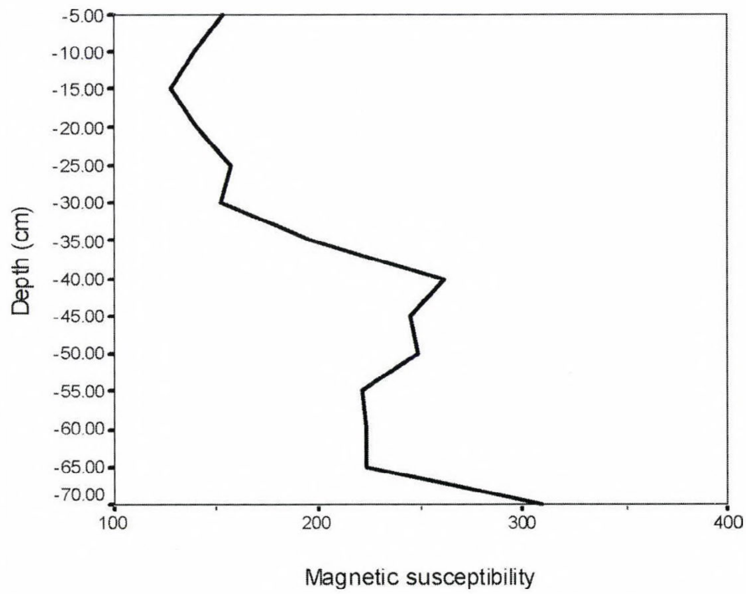


Fig. 12.6. Column14631. Variations in χ (10^{-8} SI) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

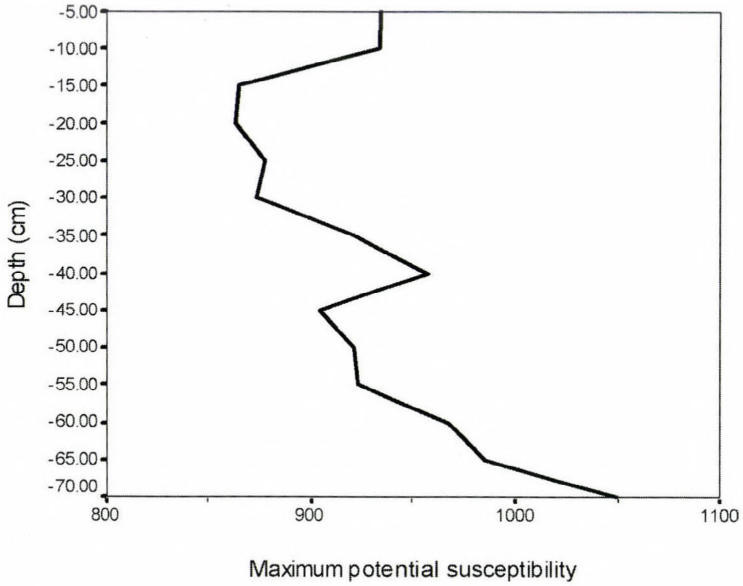


Fig. 12.7. Column 14631. Variations in χ_{max} (10^{-8} SI) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

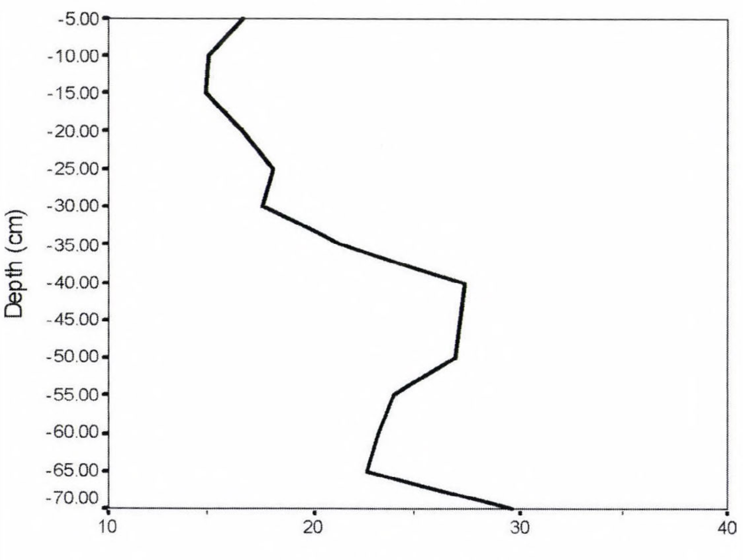


Fig. 12.8. Column 14631. Variations in χ_{conv} (%) in section extending from modern ground surface to below the occupation deposits. Samples were taken in 5 cm slices from 0–5 cm to 65–70 cm. The depth plotted corresponds with the bottom of the slice (e.g. 5 cm represents 0–5 cm)

Column 10784 (Trench 23B): midden material overlying disturbed natural

This column extends from the top of what was interpreted in the field as being midden material into the underlying subsoil. The two uppermost samples both have a high phosphate-P concentration of > 5.00 mg g^{-1} (maximum, 7.40 mg g^{-1} at 11–16 cm), which is consistent with the deposits being midden-derived. The majority of the phosphate present is in an inorganic form, with a P_i:P ratio of > 70%. Similar ratios were found in other samples on which fractionation was undertaken, with many having values > 85% *(Table 12.1)*. This clearly suggests that if the principal source of enrichment was in the form of inputs of organic matter (excluding bone, in which most phosphate occurs in an inorganic form), then this has been very largely mineralised. As in Column 14631, the phosphate-P concentration falls off rapidly into the underlying natural (2.59 mg g^{-1} at 22–27 cm).

The results for χ, while also showing a general decrease with depth, do not show the same levels of enhancement as those recorded in Column 14631. Indeed, the peak values recorded are lower than those recorded in the modern topsoil of 14631. It is unfortunate that in these cases no samples were taken of the overlying topsoil, as it may well be that the chemical and magnetic properties of the topsoils have been strongly affected by the properties of the underlying soil; that is, the topsoil overlying 10784 could well display low χ values.

Additional sequences of samples taken through occupation deposits in squares L10 and C15

Two additional sets of samples were taken to complement the thin sections investigated from contrasting parts of the occupation deposits: square L10 (W extension) [KT14590; KT = Kubiena tin] – an area that showed little visible sign of human activity; and C15 (N extension) [KT14647] – a finds-rich area. The phosphate-P *(Table 12.1)* and magnetic susceptibility data *(Table 12.2)* very clearly reflect the artefactual evidence, thereby supporting the idea that certain parts of the site were used differently, or at least at different intensities, than others (see also below).

Magnetic susceptibility data for specific anthropogenic materials

In the course of the excavation, several materials of anthropogenic origin were identified: burnt daub, what appeared to be a burnt daub with a pale-coloured 'plaster' surface, pottery sherds and ash deposits. Some of these are present in abundance, and might therefore be potentially significant in affecting magnetic susceptibility of the soils. Upon analysis the pale 'plaster' was found not to be a lime-based coating (as had originally been supposed), though it is referred to here as 'plaster'. It might be part of the lining from the inner surface of a putative kiln or oven, probably the floor surface (Macphail, chapter 11; Carneiro and Mateiciucová, chapter 13). Analytical data for samples of these materials are presented here, along with the results of experimental burning of some daub made from the natural silty clays present at the site. Summary statistics for the samples of burnt daub, 'plaster', pottery sherds and experimental burnt daub are presented in *Table*

Table 12.4. Summary of magnetic susceptibility data for the burnt daub, 'plaster' surface on daub, pottery sherds and experimental daub

	n†	Mean	Minimum	Maximum	Std dev.
χ (10^{-8} SI)					
Burnt daub [1,2] §	14	1040	162	1900	551
'Plaster' surface [3,4]	4	1660	1230	2070	345
Pottery sherds [1,4]	7	354	119	917	192
Experimental burnt daub [2,3]	3	146	68.8	298	131
χ_{max} (10^{-8} SI)					
Burnt daub [1]	14	1540	357	2670	752
'Plaster' surface [2]	4	1800	1370	2180	332
Pottery sherds [1,2]	7	605	247	917	277
Experimental burnt daub	3	1220	1220	1230	5.77
χ_{conv} (%)					
Burnt daub [1,2]	14	66.1	45.4	86.8	13.0
'Plaster' surface [1,3,4]	4	92.0	88.0	95.0	3.60
Pottery sherds [3,5]	7	56.8	48.2	70.3	8.62
Experimental burnt daub [2,4,5]	3	12.0	5.59	24.4	10.8

† *n* = number of samples analysed
§ One-way analysis of variance (using Scheffé procedure) was undertaken to compare the mean values. Superscripts indicate a significant difference ($p < 0.05$) in mean values between sample types with the same superscript value, e.g. there is a significant difference in χ between burnt daub and both pottery sherds and experimental burnt daub, but not between burnt daub and the 'plaster' surface

12.4, along with the results of analysis of variance (using Scheffé procedure) to compare the mean values for each type of material.

Burnt daub

Burnt daub is quite extensive within the occupation deposits of Trench 23B. The 14 samples analysed display considerable variability in terms of χ (range, 162–1900 x 10^{-8} SI), χ_{max} (357–2670 x 10^{-8} SI) and χ_{conv} (45.4–86.8%): presumably reflecting differences in the Fe content of the sediments used to make the daub, and the circumstances of heating/burning. On the whole, however, the burnt daub can be characterised as having very high χ (mean, 1040 x 10^{-8} SI) and χ_{conv} (mean, 66.1%) values. In order to have produced such a high fractional conversion, the burning that took place must have been at a very high temperature and must, for part of the time, have involved development of a reducing environment. It is difficult to imagine how the burning of the wattle and daub building would have created the necessary conditions to cause the degree of susceptibility enhancement recorded.

Experimental burnt daub

The levels of susceptibility enhancement achieved in the burning experiments were significantly lower than those recorded in the burnt daub from the site. This could well simply reflect the small scale of the experiment, which is unlikely to have generated the necessary high temperatures or reducing conditions for marked enhancement. Despite their obvious limitations, these results perhaps cast further doubt on the origins of the supposed burnt daub.

'Plaster'

The pale-coloured 'plaster' has a high χ (range, 1230–2070 x 10^{-8} SI) and exceptionally high χ_{conv} (range, 88.0–95.0%). The latter figures are consistent with repeated heating to very high temperatures in circumstances in which reducing conditions might periodically obtain. Despite the small sample size ($n = 4$), the mean χ_{conv} (92.0%) is significantly higher than that of the burnt daub. Undoubtedly, if additional samples had been taken, then the difference in the mean χ values would also have been statistically significant. These results support the idea that this pale material is from the inner lining of a kiln. The notably high potassium concentration recorded in this layer (see chapter 11) suggests that this is likely to be from the floor of the kiln, with the potassium being derived from wood ash.

Pottery sherds

The pottery sherds are perhaps most clearly distinguished by their much lower mean χ_{max} (605 x 10^{-8} SI) than either the burnt daub or the 'plaster'. This suggests a lower Fe content, which is clearly indicative of a different source material. Although the mean χ (354 x 10^{-8} SI) is also significantly lower, the mean χ_{conv} (56.8%) does not differ significantly from that of the burnt daub.

Ash

One sample of ash from pit 390 (sample 14327, context 474) was analysed. This displays very high χ (633 x 10^{-8} SI) and χ_{conv} (70.1%) values. It is also characterised by having a very low LOI (1.79%), a high phosphate-P concentration (5.12 mg g^{-1}), and a high pH (8.4) and carbonate content (24.5%).

Soils in close proximity to burnt daub

Soil samples were taken from the immediate vicinity of several pieces of burnt daub within the occupation deposits in order to try to gain some insight, through magnetic susceptibility analysis, into whether the burning took place *in situ* (i.e. the underlying soils/deposits have been subject to heating) or had taken place elsewhere. Attention focused primarily upon the main patch of burnt daub, located in the North Extension of 23B (context 458: see chapter 9). In this case, samples were taken in 2.5 cm slices along two 10.0 cm transect lines ('left' and 'right') running laterally from the edge of the daub, and also in 2.5 cm slices to a depth of 20 cm down below the centre of the daub. The results *(Table 12.2)* show there to be marked local spatial variability in the degree of susceptibility enhancement, with samples from the right transect showing clear signs of enhancement (χ_{conv}, range: 17.5–25.9%) compared with those from the left transect (6.97–10.7%). In both cases the highest χ_{conv} was recorded in the sample closest to the daub, though the decrease with distance is not very great. In the top 15.0 cm beneath the centre of the daub there appears to be evidence of susceptibility enhancement (χ_{conv} range: 14.0–18.2%), compared soil at greater depth (3.94% at 17.5–20.0 cm). In this case, however, there is no increase whatsoever towards the top of the section *(Figs 12.9–10)*, which does not support the idea of *in situ* burning. Of the remain-

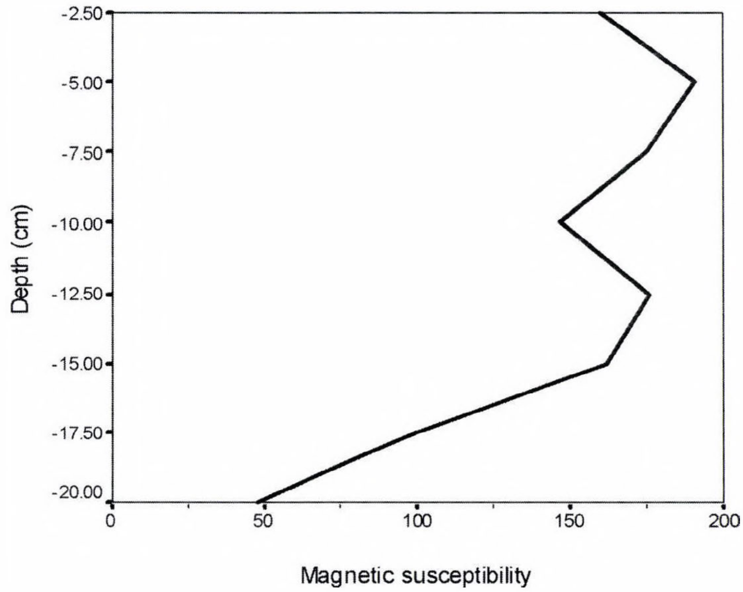


Fig. 12.9. Variations in χ (10^{-8} SI) beneath burnt daub 458 (N Extension). Samples were taken in 2.5 cm slices from 0–2.5 cm to 17.5–20.0 cm. The depth plotted corresponds with the bottom of the slice (e.g. 2.5 cm represents 0–2.5 cm)

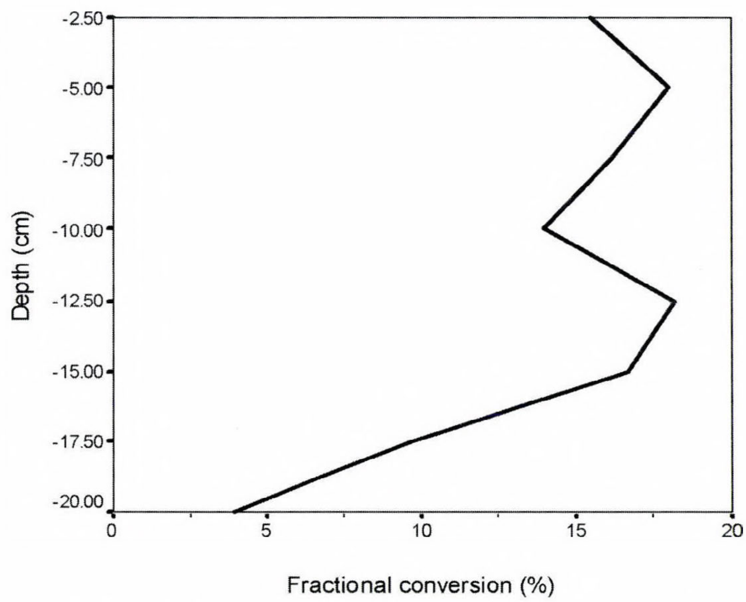


Fig. 12.10. Variations in χ_{conv} (%) beneath burnt daub 458 (N Extension). Samples were taken in 2.5 cm slices from 0–2.5 cm to 17.5–20.0 cm. The depth plotted corresponds with the bottom of the slice (e.g. 2.5 cm represents 0–2.5 cm)

ing samples taken in close proximity to burnt daub, only the sample from immediately beneath the burnt daub 'wall' in the W extension (context 438, sample 14788: χ_{conv} 21.3%) shows signs of enhancement (cf. surface samples taken adjacent to the small daub patch 452 in the W Extension in context 469 (KB 14758), χ_{conv} < 4.00%).

On the basis of these results the evidence for *in situ* burning is far from conclusive. Indeed, much of the observed enhancement in magnetic susceptibility could simply be due to fragments of daub having become detached from the main pieces and incorporated in the adjacent soil (thin sections KT 14522, 14758 and 14779; Richard Macphail, *pers. comm.*). It seems likely therefore that the daub was burned elsewhere, presumably locally on the site, and either collapsed in its present location (e.g. from a structure) or was dumped there at a later stage.

Spatial surveys of LOI, χ and phosphate-P within the occupation deposits in Trench 23B

In order to investigate spatial patterns of human activity within Trench 23B, samples were taken on a 1 m grid from occupation deposits exposed in the final phase of excavation. The survey area comprises three different sectors: the N box (excavated in 2000), identifiable as a discrete rectangular block of 15 samples in *Fig. 12.12;* the N Extension (2001), extending north from northing 13; and the W Extension (2001), running southwards down the western side from northing 12. Unfortunately, the N box was excavated to a greater depth (i.e. closer to the base of the occupation deposits) than in the N and W extensions. The data for the N box are therefore not directly comparable with those for the remaining samples.

In total, 90 samples were analysed for phosphate-P and χ. A subset of 27 of these, taken mostly on a 2 m grid, was selected for LOI, χ_{max} and χ_{conv} determinations. The results, summarised in *Table 12.5*, show there to be very marked spatial variability (phosphate-P: range, 1.01–14.7 mg g^{-1}; and χ: range, 27.1–297 x 10^{-8} SI), with very clear evidence of anthropogenic enrichment/enhancement in places. Spatial plots of the LOI, χ and phosphate-P data are presented in *Figs 12.11–13* respectively.

Although the LOI data exhibit relatively little variability within

Table 12.5. Summary of analytical data for samples taken on spatial grid across the occupation deposits

	n	Mean	Minimum	Maximum	Std dev.
LOI (%)	27	4.38	3.23	5.57	0.609
χ (10^{-8} SI)	90	108	27.1	297	64.8
χ_{max} (10^{-8} SI)	27	1060	890	1360	112
χ_{conv} (%)	27	10.0	2.09	27.8	7.08
Phosphate-P (mg g^{-1})	90	5.54	1.01	14.7	3.11

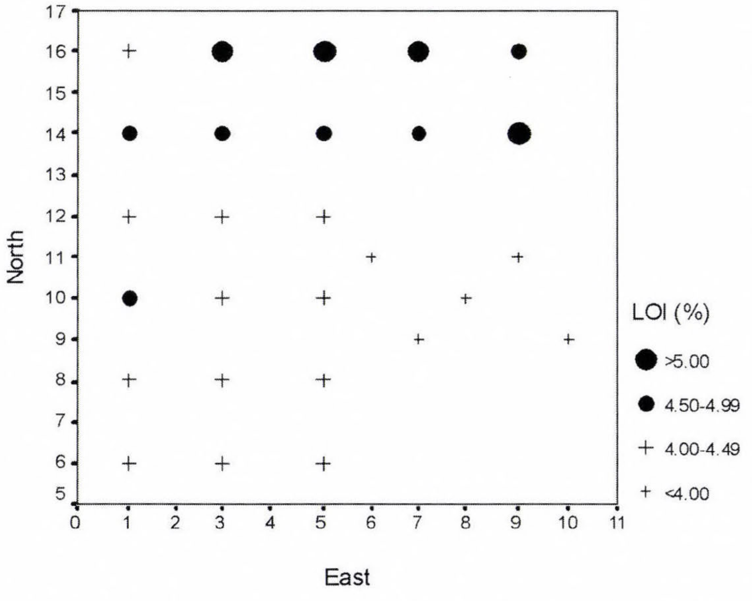


Fig. 12.11. Variations in LOI (%) at selected points across the occupation deposits (NB: on the site grid, letter codes were used for the eastings: 1 = K, 2 = L, 3 = M, 4 = A, 5 = B, 6 = C, 7 = D, 8 = E, 9 = F and 10 = G)

the survey area (range, 3.23–5.57%), there is quite a strong spatial pattern in the results *(Fig. 12.11)*. The lowest values were recorded in the N box, which presumably reflects the greater depth of sampling. Elsewhere, the values are generally higher in the N extension than W extension. In view of the time span involved and the favourable conditions for organic decomposition, it seems unlikely that these latter variations reflect actual patterns in the organic matter concentrations within the original occupation deposits. One possible explanation may be that the base of the excavation in the W extension extended closer to the base of the occupation deposits (cf. N box). Alternatively, the variations could be attributable to differences in the depth of the occupation deposits beneath the present ground surface: that is, if the thickness of the overlying soil increases from north (which is towards the top of the slope) to south, then there is a greater chance of organic enrichment from present-day pedogenic processes in the north than the south.

The results from the subset of samples shows that the variability in χ_{max} is relatively small (range, 890–1360 x 10^{-8} SI) compared with that in χ. As a consequence, there is an extremely strong relationship between χ and χ_{conv} ($r = 0.993$, $p < 0.001$; *Table 12.6; Fig. 12.14*). Under these circumstances, the χ plot presented in *Fig. 12.12* can be safely assumed to reflect variations in the degree of susceptibility enhancement across the survey area. What these data reveal is a clear area of enhancement in the eastern part of the N extension. Unfortunately, it is impossible on the basis of these data to separate the effects of any inclusions of burnt daub, kiln material, ash, etc. (i.e. materials that display high levels of enhancement) from general enhancement through burning (as might be associated with burning on a former ground surface). While both χ and χ_{conv} exhibit a significant direct correlation with LOI *(Table 12.6)*, these seem unlikely to be causal relationships. In contrast, the inverse relationship between LOI and χ_{max}

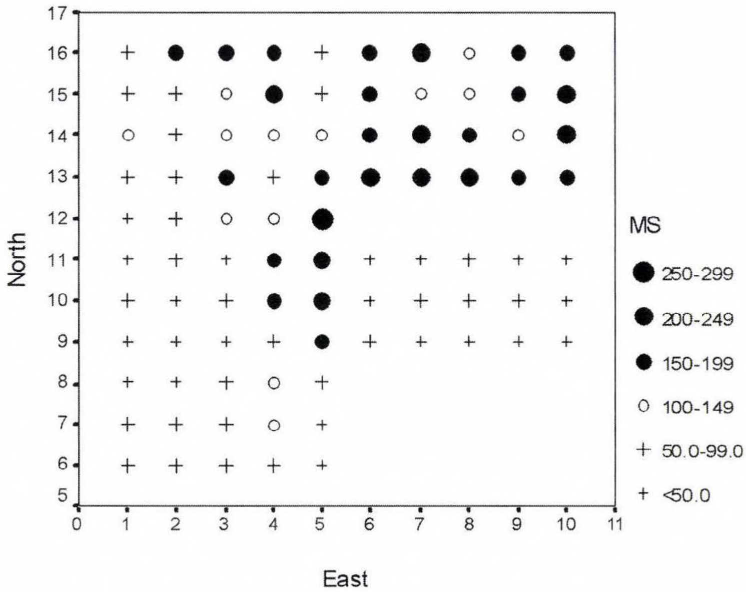


Fig. 12.12. Variations in χ (10^{-8} SI) across the occupation deposits (NB: on the site grid, letter codes were used for the eastings: 1 = K, 2 = L, 3 = M, 4 = A, 5 = B, 6 = C, 7 = D, 8 = E, 9 = F and 10 = G)

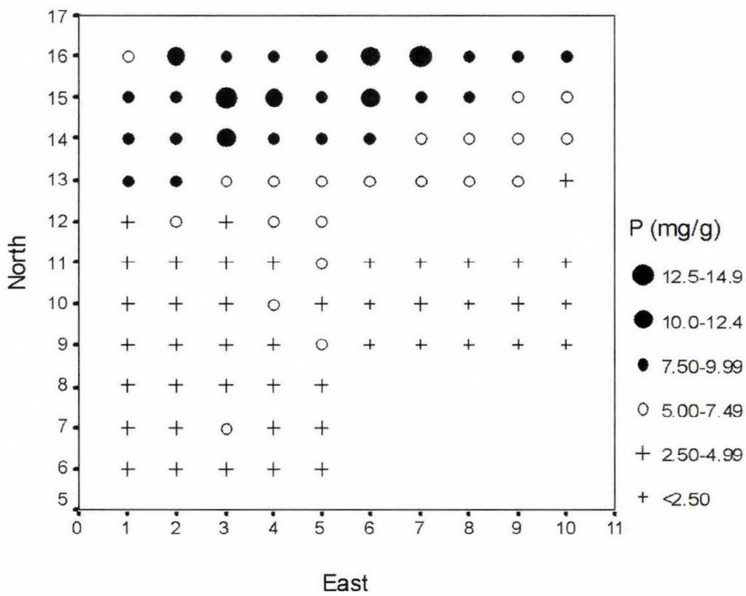


Fig. 12.13. Variations in phosphate-P concentration (mg g^{-1}) across the occupation deposits (N.B. On the site grid, letter codes were used for the eastings: 1 = K, 2 = L, 3 = M, 4 = A, 5 = B, 6 = C, 7 = D, 8 = E, 9 = F and 10 = G)

Table 12.6. Pearson correlation coefficients (r) for relationships between soil properties of samples taken on spatial grid across occupation deposits (n = 90 for relationship between χ and phosphate-P, otherwise n = 27)

	χ	χ_{max}	χ_{conv}	Phosphate-P
LOI	0.547*	−0.467*	0.567*	0.789**
χ		ns	0.993**	0.545*
χ_{max}			−0.448*	ns
χ_{conv}				0.607*

Statistical significance of r: ** $p < 0.001$; * $p < 0.05$; ns = not significant (no r value shown)

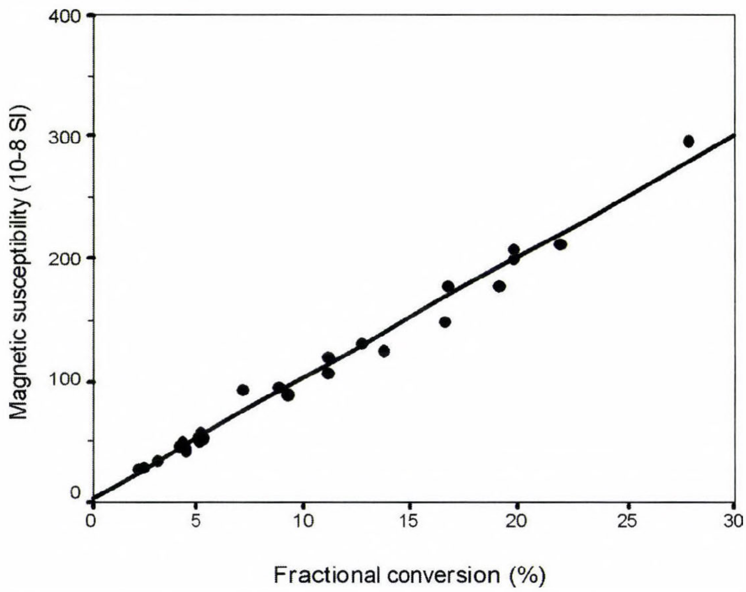


Fig. 12.14. Plot of relationship ($r = 0.993$, $p < 0.001$) between χ (10^{-8} SI) and χ_{conv} (%) for samples taken on grid across the occupation deposits

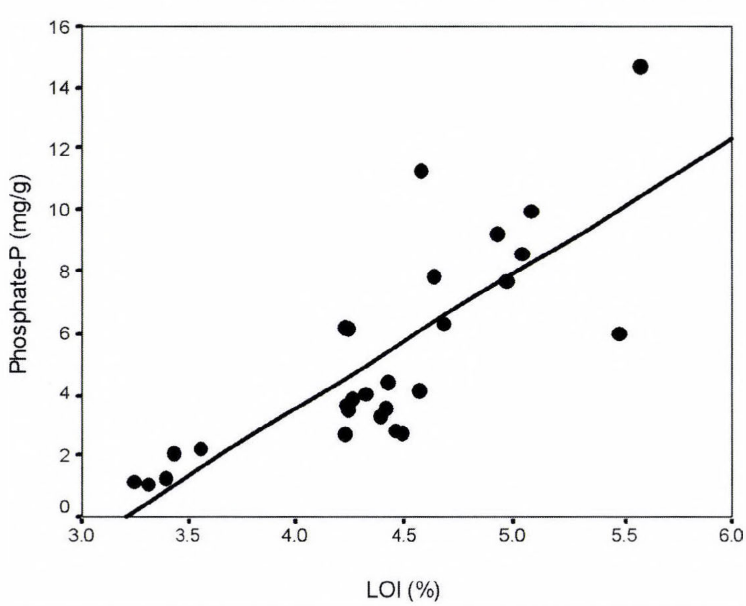


Fig. 12.15. Plot of relationship ($r = 0.789$, $p < 0.001$) between phosphate-P and LOI for samples taken on grid across the occupation deposits

may be a reflection of the general increase in χ_{max} down through the soil (as observed in Column 14631; *Fig. 12.7*); that is, where the overlying cover is thinner, not only will the soil be slightly more organic at the depth sampled, but it will also have a lower χ_{max}.

As noted above, it is quite rare for phosphate concentrations to exceed 5.00 mg g^{-1}. The fact that more than half of the samples have values in excess of this, and that 7 of the 90 samples have values ≥ 10.0 mg g^{-1} (maximum, 14.7 mg g^{-1}), clearly indicates that there was substantial phosphate enrichment within some of the occupation deposits. There is a strong relationship between phosphate-P and LOI ($r = 0.789$, $p < 0.001$; *Table 12.6; Fig. 12.15*). It seems unlikely that this is a direct causal relationship (as might be the case if phosphate-P_o was the dominant form of phosphate present), for two reasons. First, the variability in LOI is so small relative to that of phosphate-P; and secondly, very high P_i:P ratios have been recorded where phosphate fractionation analysis has been undertaken on the site. Under these circumstances, it is very likely that the patterns in the data *(Fig. 12.13)* do actually reflect variations associated with human activity patterns.

As with the χ survey, the strongest evidence of phosphate enrichment is in the N extension, though in this case it is particularly in the western half (cf. weaker relationship in *Fig. 12.16*). These separate areas of phosphate enrichment and χ enhancement might possibly be attributable to areas of midden deposits and domestic activity, respectively. Unfortunately, it is impossible on the basis of phosphate analysis alone to establish whether the phosphate enrichment resulted from organic accumulations (e.g. excreta, food residues, etc.); from mineral phosphate (hydroxyapatite) derived from the abundant bone remains found (Bartosiewicz, this volume); or from a combination of the two. The exceptionally high values recorded in several of the samples seem likely to be associated with bone.

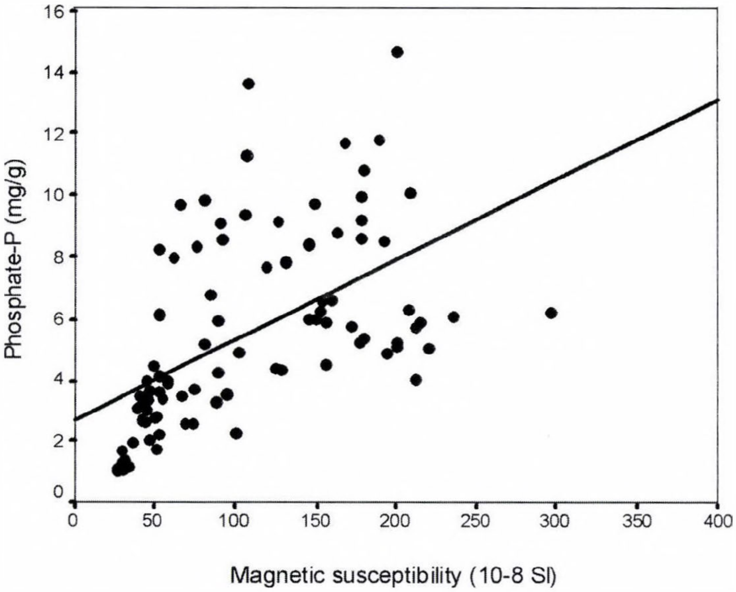


Fig. 12.16. Plot of relationship ($r = 0.545$, $p < 0.001$) between phosphate-P (mg g^{-1}) and χ (10^{-8} SI) for samples taken on grid across the occupation deposits

Pit fills

Four sequences of pit fills were investigated. In some cases samples were taken at regular intervals down through the sequence, whereas in others individual contexts were sampled (details presented in *Appendix 12.1*).

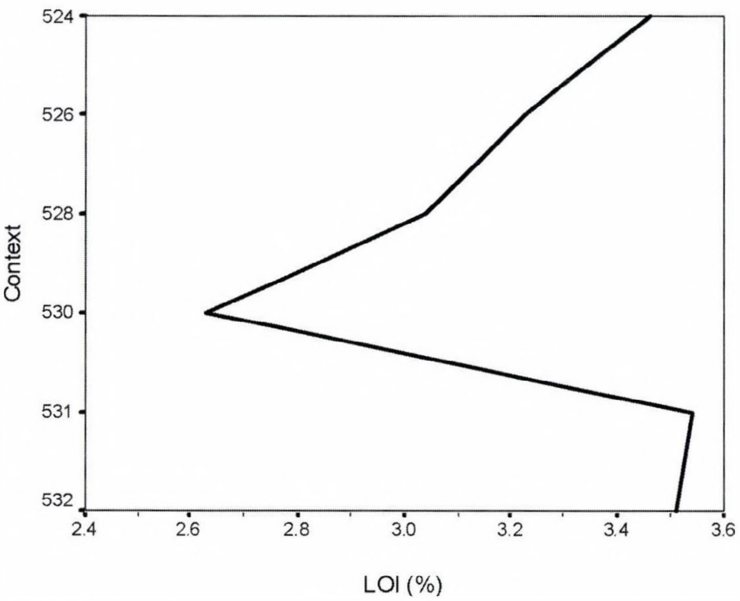


Fig. 12.17. Variations in LOI (%) down Pit XY14–15 (Trench 23C), Column 9641

Pits/scoops, Column 1241 (Trench 23A)

This column extends through various occupation deposits into the underlying subsoil (see chapter 9). It displays a reduction in phosphate-P with depth, with the samples from 0–30 cm having concentrations in excess of 5.00 mg g^{-1}. These levels are likely to indicate phosphate enrichment. The results for χ, while also showing a general decrease with depth, show only low levels of enhancement, with χ_{conv} ranging from 5.28–6.38% in the top 30 cm of soil. Sample 1241d (from 30–45 cm), which is described as including 'red dump' material, shows the strongest indications of susceptibility enhancement, though even in this case χ_{conv} (8.67%) is not especially high.

Pit 390 (Trench 23B)

The analytical data from Pit 390 reveal very pronounced variability. Working up through the sequence, the most notable change occurs between contexts 373 and 369. The lower contexts show no clear sign of phosphate-P enrichment or χ enhancement and are also characterised by having low carbonate concentrations and a high χ_{max}. The higher contexts, in contrast, generally have elevated phosphate-P, χ and χ_{conv} values and are also carbonate-rich, with a corresponding reduction in χ_{max} (presumably due to the 'dilution' effect of the carbonate; Crowther 2003). Greatest phosphate enrichment is evident in contexts 348, 341 and, particularly, 345 (phosphate-P, 10.7 mg g^{-1}), whereas the strongest signs of burning are in contexts 348, 347 and 345. The location of the two samples associated with monolith 10785 is not shown on the section drawings supplied. However, on the basis of the analytical data, that from context 420 appears to be similar to the lower pit fills, whereas the sample from context 350 is in keeping with the higher fills. The latter shows clearer evidence of burning than sample 10779/350 from the main sequence.

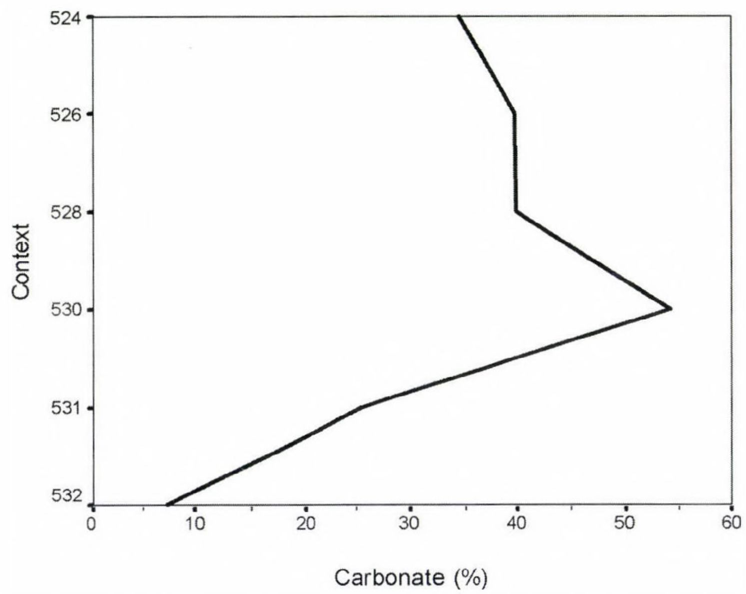


Fig. 12.18. Variations in carbonate concentration (%) down the pit section in XY14–15 (Trench 23C), Column 9641

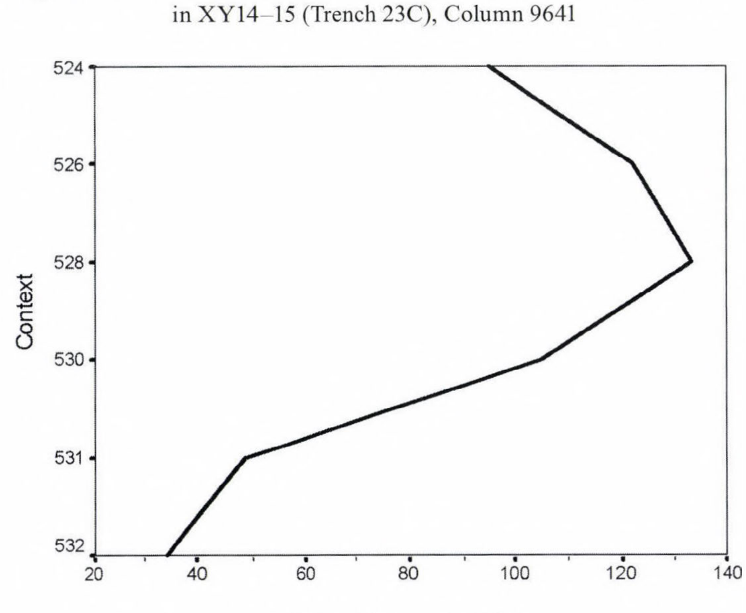


Fig. 12.19. Variations in χ (10^{-8} SI) down the pit section in XY14–15 (Trench 23C), Column 9641

Pit 393 (Trench 23B)

The contexts sampled are the base of the topsoil and two layered occupation deposits. All three samples show very high degrees of phosphate enrichment (phosphate-P range, 9.04–10.6 mg g^{-1}) and χ enhancement (χ_{conv}, 19.4–32.5%). The highest phosphate-P concentration occurs in the sample from the base of the topsoil, whereas the lowest sample (context 359) shows the strongest evidence of burning. LOI decreases down the section from 5.11% at the base of the topsoil to 3.45% in context 359.

Pit in XY14–15 (Trench 23C)

Various contexts from the pit or feature in XY14–15 were sampled in two columns: Column 9641 for contexts 524, 526, 528, 530, 531 and 532 (sampled near base of pit

Fig. 12.20. Variations in χ_{max} (10^{-8} SI) down the pit section in XY14–15 (Trench 23C), Column 9641

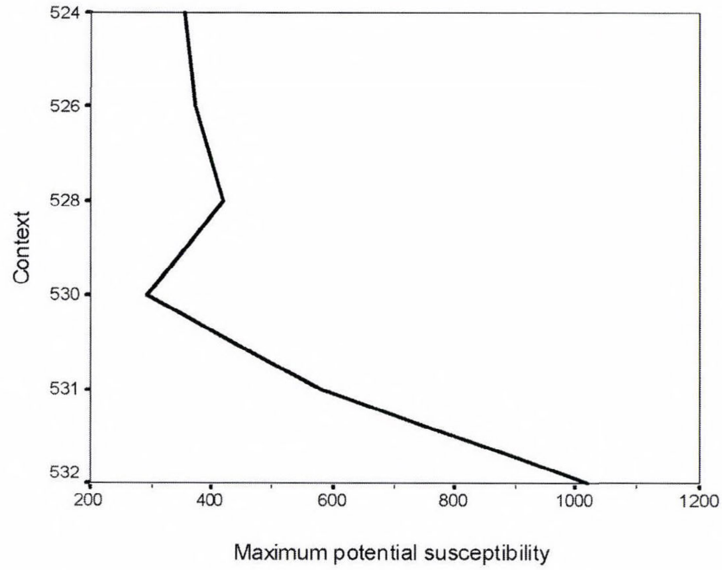


Fig. 12.21. Variations in χ_{conv} (%) down the pit section in XY14–15 (Trench 23C), Column 9641

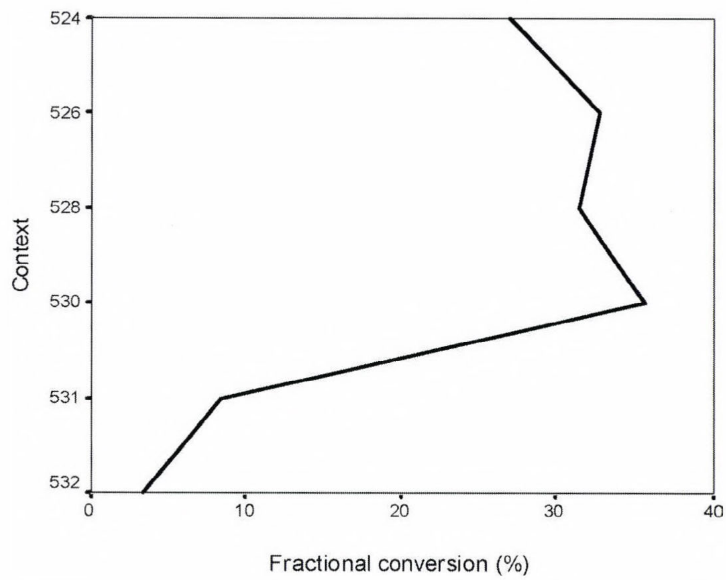
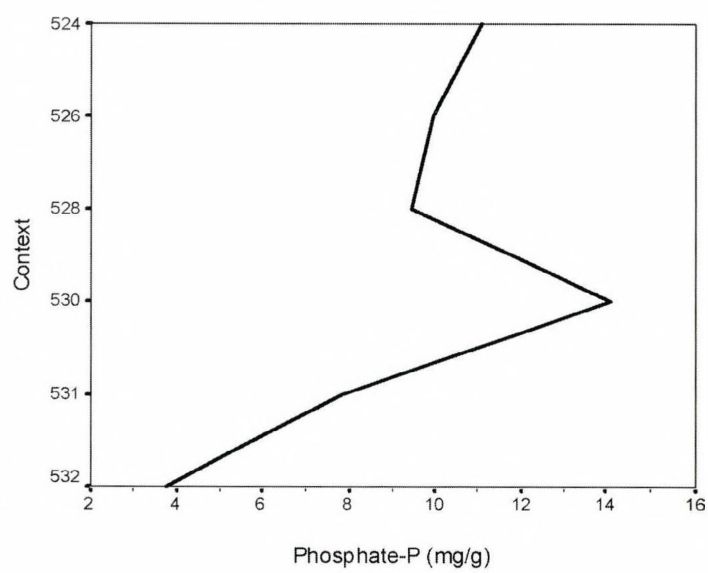


Fig. 12.22. Variations in phosphate-P concentration (mg g^{-1}) down the pit section in XY14–15 (Trench 23C), Column 9641



fills in 2001; see *Figs 12.17–22*); and Column 9381 for contexts 511, 512 and 514 (sampled near top of pit fills in 2000). As in the previous pits the various contexts sampled display very marked variability in soil chemistry and magnetic susceptibility. The lowermost two contexts (532 and 531) in Column 9641 are characterised by their relatively low carbonate and phosphate-P concentrations and χ and χ_{conv} values, and a high χ_{max}. The overlying contexts, by comparison, show much stronger signs of anthropogenic activity, with the highest carbonate (possibly partly derived from ash?), phosphate-P and χ_{conv} being recorded in context 530. Interestingly, this context also has by far the lowest LOI within the sequence, which may also be indicative of burning.

The upper three samples have very high pH values, which may be indicative of alkalisation/salinisation. The lowermost context sampled was 514, which was much darker than seen in the deposits below (see chapter 9). While its low LOI (3.01%), carbonate (3.96%) and χ_{conv} (2.50%) are in keeping with a natural channel fill, the phosphate-P concentration (4.22 mg g^{-1}) is considerably higher than would be anticipated in a 'natural' deposit, and this may suggest some anthropogenic influence here too. The overlying contexts (512 and 511), which are unambiguously interpreted as being occupation deposits, both show signs of phosphate enrichment, with a maximum phosphate-P concentration of 7.83 mg g^{-1} in context 511. The latter context also has a χ_{conv} value of > 10.0%, which is indicative of magnetic enhancement. However, neither of these occupation contexts displays the high phosphate-P and χ_{conv} levels observed in some contexts in Trench 23B, nor are they carbonate-rich. This perhaps suggests a lower intensity of human activity in this part of the site, an interpretation which appears to be in accord with the field evidence (see chapter 9, this volume). It should be noted that the LOI values for contexts 512 and 511 are both low (maximum, 3.78%), which would not appear to support the idea of them originating as a 'marshy soil' (which is suggested as a possibility in the context descriptions).

Acknowledgements

The author wishes to thank Richard Macphail and Alasdair Whittle for their collaboration. The laboratory analysis was undertaken by Ian Clewes.

Appendix

Appendix 12.1. Details of samples analysed

Sample/context (depth in cm)	Description
TRENCH 23A	
Pits/scoops, Column 1241: extending through occupation deposits into underlying subsoil	
1241a (0–10)	Occupation
1241b (10–20)	Occupation
1241c (20–30)	Occupation
1241d (30–45)	Occupation/red dump
1241e (45–56)	Contaminated subsoil
1241f (56+)	Natural subsoil

Appendix 12.1. Continued

Sample/context (depth in cm)	Description
TRENCH 23B	
Column 14631: extending through modern soil to below occupation layers in N extension (n = 14)	
14716/422 (0–5)	
14717/422 (5–10)	
14718/422 (10–15)	
14719/422 (15–20)	
14720/422 (20–25)	
14721/422 (25–30)	
14722/445 (30–35)	
14723/464 (35–40)	
14724/488 (40–45)	
14725/489 (45–50)	
14726/490 (50–55)	
14727/490 (55–60)	
14728/491 (60–65)	
14729/492 (65–70)	
Column 10784: midden material overlying disturbed natural	
10784/327 (7–11)	Continuation of occupation level below 316
10784/342 (11–16)	Continuation of occupation level below 327
10784/351 (16–22)	Continuation of occupation level below 342
10784/397 (22–27)	Continuation of occupation level below 351 (into natural?)
Sections through occupation deposits:	
Square L10	
14708–14708a	Surface in W extension: 5 cm slices [KT 14590]* (n = 2)
Square C15	
14711–14712	Surface in N extension: 5 cm slices [KT 14647] (n = 2)
Samples of specific materials	
10780/305	Burnt daub: Linear deposit of burnt daub fragments. From hearth?
11884 (n = 8, a–h)	Burnt daub: N extension ctxt 458
14323 (n = 4, a–d)	Burnt daub: N extension ctxt 464 sq M15 ('plaster' left)
14325	Burnt daub: N extension ctxt 464 sq B14
14323 (n = 4, e–h)	'Plaster' surface: N extension ctxt 464 sq M15
14326 (n = 4, a–d)	Sherd samples: N extension ctxt 464 sq K13
14327 (n = 3, e–g)	Sherd samples: N extension ctxt 469 sq M13
14328	Yellow silt
14372/474	Ash sample
Soils in close proximity to burnt daub	
14632–35	Main burnt daub 458 (N extension): Left series @ 2.5 cm intervals (n = 4)

* KT (Kubiena tin) indicates number of soil thin section studied (see chapter 11)

Sample/context (depth in cm)	Description
14658–61	Main burnt daub 458 (N extension): Right series @ 2.5 cm intervals [KT 14522] (*n* = 4)
14687–90 and 14701–04	Main burnt daub 458 (N extension): Centrally under daub wall @ 2.5 cm intervals (*n* = 8)
14771–2	Small daub patch (W extension in ctxt 469): Left side 5 cm slices [KT14758] (*n* = 2)
14773–4	Small daub patch (W. extension): Right side 5 cm slices (*n* = 2)
14788	Under burnt daub 'wall' in W extension (*n* = 1) [KT 14779]
Samples from 1 m grid across old ground surface (ctxt 470)	
10781/400F11 (0–8)	Main occupation surface. Beneath shell dump, square F11
10782/400D10 (0–8)	Main occupation surface. Trampled surface?, square D10
13890–13918/470 (even nos) (*n* = 15)	N box
13920–14068/464 and 469 (even nos) (*n* = 75)	N extension (ctxt 464) and W extension (469)
Pit 390	
5771/341	Grey silt. Uppermost fill of 390
5771/345	Brown silt. Continuation of 341
5771/347	Brown silt. Continuation of 345
5771/348	Brown silt. Continuation of 347
10779/350	Brown silt. Continuation of 348
10779/357	Variably dark to grey to brown silt. Continuation of 350
10779/369	Variably dark to grey to brown silt. Continuation of 357
10778/373 [upper]	Variably dark to grey to brown silt. Continuation of 369
10778/373 [lower]	As above
10777/378	Variably dark to grey to brown silt. Continuation of 373
10785/350	Brown silt fill (also sampled in 10779)
10785/420	Yellow silt deposit. Clay insert?
Pit 393: Base of topsoil through layered occupation deposits	
10783/topsoil (0–10)	Base of topsoil through layered? Occupation
10783/402 (10–50)	Top fill. Thin lens of grey silt with 2 dark bands. Occupation
10783/359 (50–100)	Brown-grey silt. Continuation of top fill
TRENCH 23C	
Pit in XY 14–15 (2 columns):	
Column 9381 (sampled 2000)	
9381/511	Dark clayey soil. Dumped? Occupation. Marshy soil?
9381/512	Dark clayey soil. Mixed occupation. Marshy soil?
9381/514	Yellow silt. Natural channel fill
Column 9641 [KT 9641 and 9644] (sampled 2001)	
9657/524	
9658/526	
9659/528	

Appendix 12.1. Continued

Sample/context (depth in cm)	Description
9660/530	
9661/531	
9662/532	
EXPERIMENTAL BURNING	
ExB1	Separate piece though from same firing as RM1*
ExB2	Same fragment as RM2
ExB3	Same fragment as RM3

* RM (Richard Macphail) indicates thin sections of burnt daub (see chapter 11)

Appendix 12.2. Analytical data from spatial survey across the occupation deposits

Sample	East (m)	North (m)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)	Phosphate-P (mg g^{-1})	LOI (%)
13890	G	11	30.7			1.26	
13892	G	10	27.1			1.01	
13894	G	9	47.2	1130	4.18	2.09	3.42
13896	F	9	28.2			1.72	
13898	F	10	69.9			2.58	
13900	F	11	28.4	1360	2.09	1.29	3.38
13902	E	11	99.8			2.26	
13904	E	10	53.5	1030	5.19	2.21	3.56
13906	E	9	35.4			1.96	
13908	D	9	29.5	1250	2.36	1.05	3.30
13910	D	10	75.0			2.62	
13912	D	11	27.1			1.10	
13914	C	11	33.9	1130	3.00	1.15	3.23
13916	C	9	51.0			1.75	
13918	C	10	30.3			1.38	
13920	G	16	178			8.64	
13922	G	15	200			5.10	
13924	G	14	201			5.27	
13926	G	13	194			4.90	
13928	F	13	180			5.35	
13930	E	13	220			5.02	
13932	D	13	235			6.08	
13934	D	14	208	1050	19.8	6.32	4.69
13936	F	14	149	890	16.7	5.99	5.47
13938	F	15	156			5.87	
13940	F	16	178	928	19.2	9.21	4.93
13942	E	16	105			9.36	
13944	D	16	200	1010	19.8	14.7	5.57
13946	C	16	180			10.8	
13948	C	15	189			11.8	

Appendix 12.2. Continued

Sample	East (m)	North (m)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)	Phosphate-P (mg g^{-1})	LOI (%)
13950	B	16	92.1	1270	7.25	8.59	5.04
13952	A	16	163			8.81	
13954	M	16	178	1060	16.8	9.94	5.08
13956	L	16	168			11.7	
13958	K	16	52.9	1040	5.09	6.13	4.23
13960	K	15	90.6			9.12	
13962	K	14	131	1040	12.6	7.84	4.64
13964	K	13	81.4			9.86	
13966	C	13	212			5.72	
13968	B	13	153			6.59	
13970	D	15	148			9.76	
13972	A	15	209			10.1	
13974	B	12	297	1070	27.8	6.18	4.21
13976	A	12	145			5.99	
13978	B	11	215			5.87	
13980	A	11	155			4.49	
13982	A	10	152			6.24	
13984	B	10	212	972	21.8	4.01	4.31
13986	A	9	89.6			4.22	
13988	B	9	177			5.27	
13990	E	14	172			5.75	
13992	E	15	145			8.45	
13994	K	11	49.0			4.46	
13996	C	14	192			8.52	
13998	B	14	119	1070	11.1	7.66	4.97
14000	B	15	77.0			8.36	
14002	A	14	126			9.16	
14004	M	9	38.5			3.09	
14006	L	9	40.7			3.15	
14008	L	10	44.8			3.97	
14010	M	10	89.4	966	9.25	3.26	4.38
14012	M	11	44.8			3.03	
14014	L	11	53.6			3.58	
14016	L	12	81.4			5.18	
14018	M	15	107			13.6	
14020	L	15	53.1			8.28	
14022	L	14	66.6			9.71	
14024	M	14	106	953	11.1	11.3	4.58
14026	L	13	62.4			8.00	
14028	M	12	125	914	13.7	4.39	4.42
14030	M	13	160			6.61	
14032	A	13	84.5			6.80	
14034	B	8	95.3	1070	8.91	3.57	4.41
14036	A	8	128			4.32	
14038	M	8	58.7	1120	5.24	3.86	4.25

Appendix 12.2. Continued

Sample	East (m)	North (m)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv} (%)	Phosphate-P (mg g^{-1})	LOI (%)
14040	L	8	40.8			3.51	
14042	K	8	41.9	948	4.42	2.70	4.21
14044	B	7	45.9			3.32	
14046	A	7	102			4.91	
14048	M	7	90.5			5.93	
14050	L	7	67.8			3.51	
14052	K	7	76.0			3.70	
14054	B	6	46.8	1130	4.14	3.66	4.22
14056	A	6	58.3			3.95	
14058	M	6	50.1	1170	4.28	2.76	4.49
14060	L	6	55.2			3.39	
14062	K	6	50.7	987	5.14	2.79	4.46
14064	K	9	43.7			2.64	
14066	K	10	53.1	991	5.36	4.11	4.57
14068	K	12	44.6	1010	4.42	3.52	4.23

Chapter 13

DAUB FRAGMENTS AND THE QUESTION OF STRUCTURES

Ângela Carneiro and *Inna Mateiciucová*

Introduction and objectives

As already described in chapter 9, considerable quantities of daub were found across much of Trench 23B, particularly in the North extension, part of the West extension and in the North box. Impressive quantities were also found in the Centre-West and Centre-East boxes, decreasing somewhat in the South-West and South-East boxes. The daub fragments were generally well preserved and distributed throughout the deposit. Many small finds were also uncovered in this area, including sherds of ceramic vessels, clay weights, animal bones and stone tools which give insight into everyday settlement activities. The daub fragments probably represent the remains of buildings of some kind. These may well have been inhabited, but in view of the present state of uncertainty, this report will attempt to use the term 'house' critically, and we often use the term 'structure' as a more neutral substitute.

Since the Ecsegfalva archaeological project was aimed at the detailed study of a small area, no complete structural plan was uncovered. Therefore, we cannot answer questions regarding the size, overall appearance and function of the structures in question. On the other hand, this detailed research permitted the acquisition of a large number of daub samples with well preserved impressions of other building materials. These constitute a significant database for the study of building materials and techniques of construction, which form the foundation for additional research regarding Early Neolithic architecture.

In the study of structural remains at Ecsegfalva, we have focused on questions which correspond with the main aims of the project. Their answers may increase our understanding of the lifeway of the Early Neolithic Körös culture. These questions include the following:

- Did people in the Körös culture construct substantial permanent houses, or do their structures represent something insubstantial and short-term?
- What kind of building materials did they use? Do the building materials indicate adaptation to local resources?
- Are there differences between the building materials used in contemporaneous constructions throughout the Balkans and the Carpathian Basin?
- What was the daub made from? Did they add chaff associated with domesticated or wild vegetation?
- Are the daub remains the remnants of one or more constructions?
- Can we make specific statements regarding settlement continuity?
- What caused the demise of the structures?
- Was the fire which resulted in the preservation of daub the result of deliberate or accidental burning?
- What caused the demise of structures at other Körös culture settlements?

Indications of Körös culture architecture

Before we begin to describe the analysis of the daub from Ecsegfalva, we will briefly summarise the state of knowledge regarding Körös culture architecture.

Körös culture structural remains are rare. The majority of known structures were identified more than 20 years ago (Banner 1934; 1942; 1943; Kutzián 1944; Garašanin 1961; Kalicz 1965; Trogmayer 1966; Szekeres 1967; Selmeczi 1969; Tringham 1971, 84–87; Kalicz and Raczky 1980–81; Horváth 1989, 85–86; Makkay 1992). These excavations provide a rough estimate of what a Körös house may have looked like. Unfortunately, information regarding other Körös structures, such as granaries for staple foods, structures for storage and structures for livestock, is almost lacking. From current sources we know that people of the Körös culture based their settlements near water. Individual houses might have been constructed in one or two rows along terrace edges and levees. The full extent of these settlements is uncertain. According to János Makkay, smaller Körös settlements consisted of five to ten houses and larger ones may have had 50 or more houses (Makkay 1982a; Sherratt 1983b, 161; Horváth 1989, 86; Kalicz 1998, 259). Whether or not all the houses in the larger settlements were occupied simultaneously is uncertain.

Ground plans of Körös culture structures are usually rectangular with an area of approximately 30–35 m^2, and exceptionally up to 50 m^2. The length of the shorter walls often falls between 4–5 m and the longer walls fall between 6–10 m. The structures were often oriented NW-SE. The interior of the structures comprised normally one room, but occasionally two rooms. Pits were often located near the structures, and were probably originally used to obtain clay for daub. Hearths have been found both inside and outside the houses. Beehive-shaped plastered storage pits are typical for the Körös culture. Large vessels used for storage were also sunk into the ground and covered with a ceramic bowl. Storage pits and storage vessels have been identified both inside and outside the structures. The Körös culture is distinguished by the wealth of its settlement remains (Banner 1942, 17; Kalicz and Raczky 1980–81, 14; Sherratt 1983b, 163; Horváth 1989, 86; Kalicz 1998, 258–59; Whittle 2000, 13; 2003, 5).

Previously, the construction of Körös structures has not received much attention. Based on current findings, most structures were constructed using a framework of upright wooden posts and complemented with walls of plaited branches or wattle, plastered on both sides with daub, like the wattle-daub walls from Tiszajenő. In other cases, for example at Szolnok-Szanda, reed walls have also been considered, wherein the space between vertical posts was filled with reed bundles affixed horizontally, probably supported by wooden planks or strong branches, and plastered with daub (Tringham 1971, 86; Kalicz and Raczky 1980–81, 15).

We know very little about internal furnishing. In some houses, hearths have been found to be up to 1 m in diameter, and some have been interpreted as simple ovens. They were often placed across from entrances. The entrance was usually placed on the short walls. Fragments of large storage vessels have been found near some hearths. Alternatively, clay loom weights have also been identified near hearths, possibly indicating textile manufacture, or aspects of building construction, perhaps as roofing weights (see chapter 28). Remains of clay floors, sometimes several centimetres thick, have also been identified inside some structures. The roof was probably gabled, as indicated by the clay model of house found at Röszke-Lúdvár and by other archaeological data (Tringham 1971, 84–87; Kalicz and Raczky 1980–81, 14; Horváth 1989, 85–86). The roofing material was probably reed thatch or another organic material.

The remains of structures found at Körös culture settlements were often preserved by fire (Kalicz and Raczky 1980–81, 15; Makkay 1992, 121; Kalicz 1998, 259). Whether house fires in the Körös culture were deliberate or accidental has not been previously considered. Deliberate burning is known from the Balkans, especially during the Middle and Late Neolithic, comprising the Vinča, Boian and Cucuteni-Tripolye cultures. It is also anticipated in the earliest Karanovo culture. In the Carpathian Basin, deliberate house burning is characteristic for the Tisza culture and is also considered for the late Starčevo culture. On the Great Hungarian Plain, the earliest deliberate house burning is attributed to the Szakálhát culture (Stevanović and Tringham 1997, 200, 207, fig. 1). The end of this chapter addresses the question of deliberate versus accidental burning of houses in the Körös culture.

Description of the daub fragments at Ecsegfalva 23

All daub was recorded per square metre, and many fragments were recorded in their exact position (e.g. *Figs 9.18* and *9.24*). All daub fragments were retained after excavation. Unfortunately, due to the massive quantities obtained, it was not possible to examine all daub fragments. It was possible, however, to closely examine a sample. The sample was selected over a two-week period in the Archaeological Institute, Budapest, in the summer of 2002 in conjunction with the excavator, from the upper part of the deposit located in the northern section of Trench 23B. This provides a controlled starting point for the future examination of early daub structures, and permits reliable, if still rather general, inferences regarding the basic characteristics of structures identified at Ecsegfalva.

Criteria for the analysis of 3789 (121.5 kg) daub fragments are presented in *Tables 13.1–3* including temper, types and other technical details. The main division is into plant-tempered daub and daub without visible plant temper (*Table 13.1* and *Figs 13.1–2*). Percentages given refer to weight, within the sample examined for this chapter.

The temper consists especially of reed chaff (Amy Bogaard, *pers. comm.*; *Fig. 13.4*) and following ethnographic observations constitutes usually 25–30 per cent of the total daub mass (Nikolov 1989, 19). The plant-tempered daub fragments include rubble from wall plaster originating from buildings with an internal structure of wooden posts and reed mats or reed sheaves.

Table 13.1. Quantitative distribution of the studied daub material

Character of material	No. of pieces	No. of pieces (%)	Weight (g)	Weight (%)
Plant tempered daub	2289	60.41	98,894.5	81.43
Daub without visible plant temper	1500	39.59	22,556.6	18.57
Total	3789	100	121,451.10	100

Table 13.2. Frequency of structural indications from plant-tempered daub

Structural indications of plant tempered daub	No. of pieces	No. of pieces (%)	Weight (g)	Weight (%)
One side flattened (with reed impressions)	169	7.4	21,501	21.7
One side flattened (with other impressions)	23	1	2,565	2.6
Plate-like fragments (without impressions)	985	43.1	41,675.7	42.2
Plate-like fragments (with reed impressions)	10	0.5	477.1	0.5
Plate-like fragments (with other impressions)	3	0.1	129	0.1
Angle (including impressions)	55	2.4	2,966.1	3
Corner (including impressions)	17	0.7	1,054.4	1.1
Without structural indications (without impressions)	719	31.4	11,760.8	11.8
Without struktural indications (icluding impressions)	296	12.9	16,580.4	16.8
Other	12	0.5	185	0.2
Total	2289	100	98,894.5	100

Table 13.3. Frequency of structural indications from daub without visible plant temper ('clay plaster')

Context	Plant tempered daub (n)	'Clay plaster' (n)	Plant tempered daub (weight in g)	'Clay plaster' (weight in g)
301	392	76	19,454.8	538.8
305	20		2,780	
307	2	4	70	18
311	15	2	748	50
313	19	2	1,902	10
314	2	3	44	38
315		1		307
316	53	13	2,700	169
317	1		77	
333	1		404	
342	2	2	4,280	6
363	27	5	2,392	22
396	1		25	
405	9	1	1,728	24
422	1		3.5	
423	1	1	12	43
424	133	21	1,229.5	229.4
424/364	9		299	
430	286	132	9,544.2	1,463.1
431	149	125	3,124.3	1,982.6
438	52	14	1,411	251
439	1	13	12	55.1
442	33	23	1,305.2	230.3
443	5	4	95	33.2
445	88	519	5,632.4	9,350
449	9		107	
450	42		2,006.7	
457	94	43	3,830.5	629.9
458	46		4,611	
464	568	425	17,720.1	6,165.2
469	48	55	3,387	775
474	18	2	238.9	20
478	7		473	
481	52	6	3,539.4	63
497	103	8	3,708	83

Nearly half of the plant-tempered daub fragments (c. 44 per cent of the weight) yielded various imprints *(Table 13.2)*, mostly reeds (*Table 13.4* and *Fig. 13.5*). During wall construction, this daub was applied while wet on to a reed frame *(Fig. 13.6)*. Sometimes finger impressions *(Fig. 13.7)* and impressions of split timbers (*Fig. 13.8* and *13.35*) are also visible. The majority of finger impressions result from processing the clay mass and its application to the structural elements.

Other plant-tempered daub fragments comprise a kind of 'plates' with one or both sides flattened and smoothed or rough surfaces and a thickness up to 4.5 cm. They constitute c. 43 per cent of the plant-tempered sample study material *(Table 13.2)*. Some of them have reed impressions on one side *(Fig. 13.9)* but the majority do not *(Figs 13.10–14)*. They were not applied to the reed skeleton and possibly they indicate a second daub layer of walls. Some of these 'plates' are not so thick. They have an average thickness of 1.5–3 cm and are more likely small plates with both sides flattened (called 'plate-like' below) *(Fig. 13.15)*.

A few distinct small pieces of plant-tempered daub have an angular shape with a specific form like a corner, while other fragments suggest angles difficult to characterise more precisely (*Table 13.2* and *Figs 13.16–19*). We do not know exactly which part of wall or structure these may have come from. Possible roles for the angled objects as well for the plate-like daub fragments will be discussed below.

29 per cent of the plant-tempered daub fragments were indistinct *(Table 13.2)*. 16.8 per cent of them yielded isolated reed impressions, suggesting they were also applied on to the reed structures.

The majority of the plant-tempered daub fragments are well fired and have an orange colour *(Fig. 13.3)*. Among the daub apparently burned in an oxidising atmosphere, 43 vitrified daub fragments with a colour spectrum from intense grey-orange crossing to grey-green into black were also identified *(Figs 13.20–21)*.

In addition to plant-tempered daub a very fine daub was also found at Ecsegfalva 23, which did not contain any visible organic additives resembling chaff. The daub fragments without visible plant temper (called 'clay plaster' here) comprise a very fine-grained structure, whose temper

Table 13.4. Frequency of the kind of daub impressions

Kind of impressions	Plant tempered daub				Daub without plant temper	
	No. of pieces	No. of pieces (%)	Weight (g)	Weight (%)	No. of pieces	Weight (g)
Reed impressions	494	21.6	36,512.1	36.9	10	245.4
Finger impressions	4	0.2	365	0.4		
Possible finger impressions	19	0.8	609.4	0.6		
Wood impressions	21	0.9	4,325	4.4		
Other impressions	17	0.7	1,878.5	1.9	4	223.9
Subtotal	555	24.2	4,369	44.2	14	469.3
Without impressions	1734	75.8	55,204.5	55.8	1486	22,087.3
Total	2289	100	98,894.5	100	1500	22,556.6

cannot be seen with the naked eye. It cannot be excluded that they could have been tempered by other means. Some of these daub fragments were analysed micro-morphologically (see Macphail, chapter 11). The best preserved pieces have a prismatic form with two opposing surfaces. One surface is even and well smoothed (*Table 13.3* and *Fig. 13.22*). The other surface is irregular, somewhat level and contains impressions of pebbles with a irregular distribution (*Fig. 13.24*). The appearance of these surfaces indicates that daub was applied directly on to the ground while wet, and then smoothed and polished when almost dry. The irregular surface was in contact with the ground, while the smooth and polished surface formed the upper surface of a floor or smaller working surface, hearth or possibly oven (see below). These pieces were mostly 1.5 to 3 cm thick. It is difficult to define them more precisely. They were found broken in many pieces during the excavation. In the uppermost occupation layers of the North Extension in Trench 23B there was a concentration of these 'plaster-like' fragments with a thickness of 2–6 cm, of which

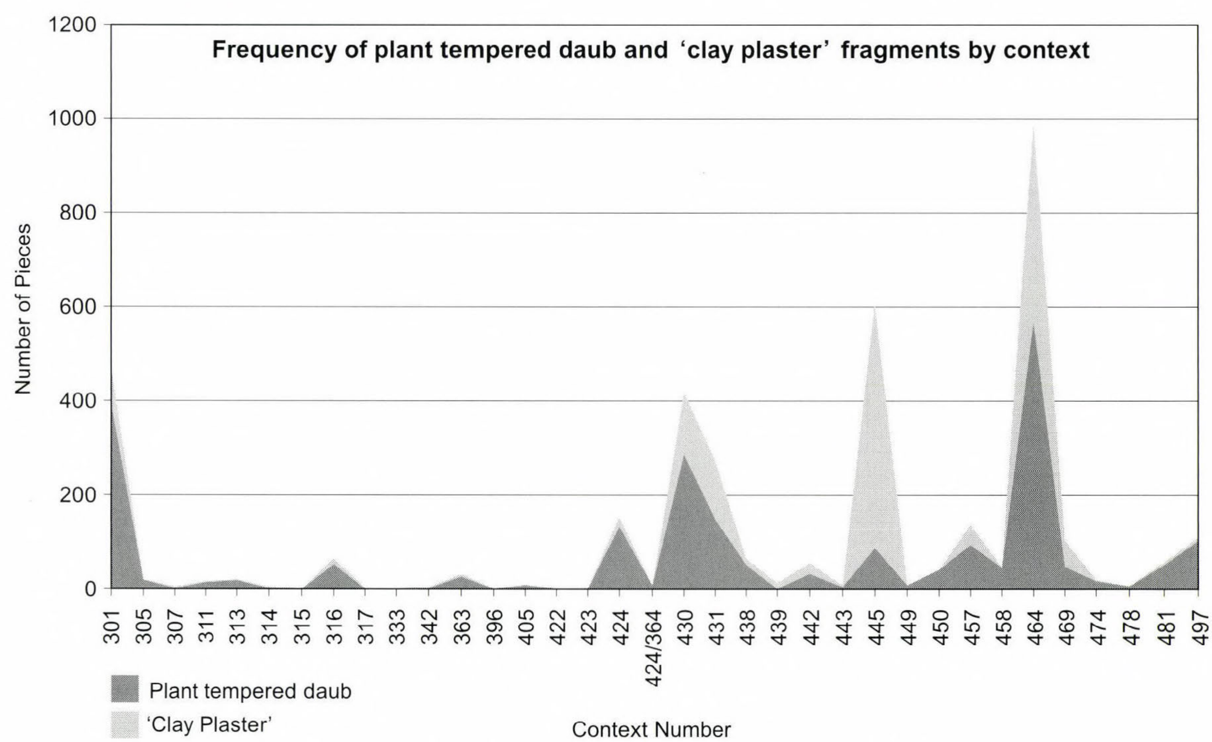


Fig. 13.1. Contextual distribution of the studied daub material by the number of fragments

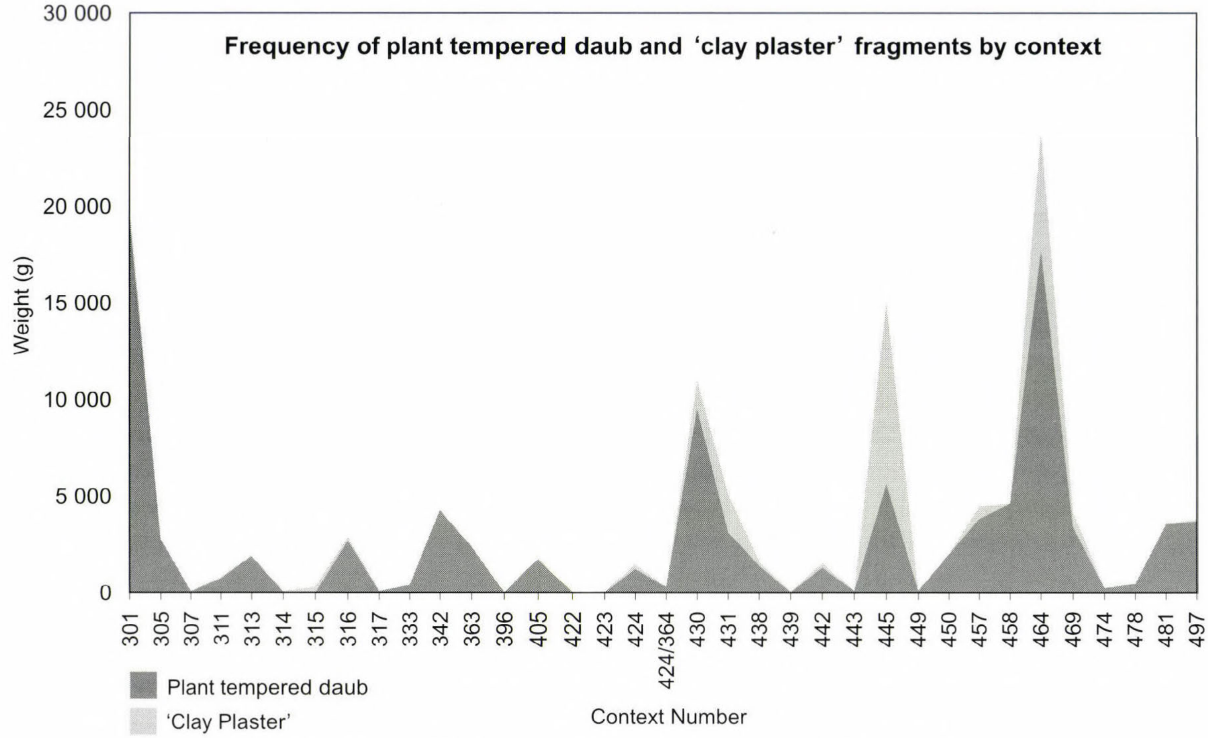


Fig. 13.2. Contextual distribution of the studied daub material by weight

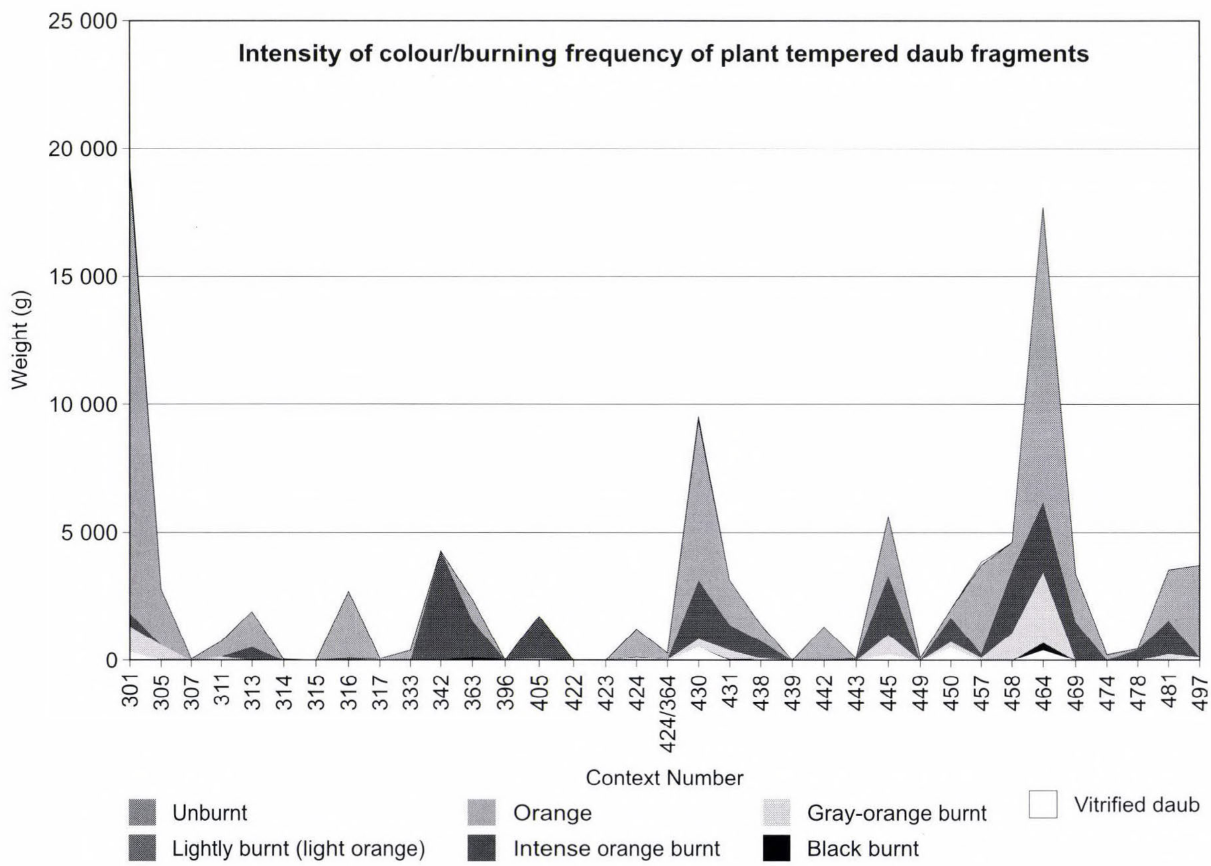


Fig. 13.3. Distribution of the colour/burning stage of the daub material by context

Fig. 13.4. Daub fragments tempered with reed chaff

Fig. 13.5. Daub fragment with an impressed reed row

several adjacent pieces could be recombined. After restoration, they indicated a surface of 25 by 40 cm *(Figs 13.23–24)*.

Building material

On the basis of information acquired from the analysis of daub and its impressions, we know that the building materials used for construction came from the immediate surroundings of the structures: clay, for the manufacture of daub for plaster; reed, for the manufacture of daub, wall construction and for roofing; and wood, in the form of posts for the supporting construction of walls and of the roof, split timbers, thin posts and branches for reinforcement of walls and roof.

Clay

Plant-tempered daub. Micromorphological analysis of soil samples indicated that sandy subsoil from the deeply weathered loess-enriched alluvium that developed on the Pleistocene levée of the Kiri-tó may have been used for daub. Micromorphological analysis of the fired daub indicated that plant-tempered daub was made from fine sandy subsoil mixed with 'top-

Fig. 13.6. Simulation of some technical details imprinting reed stalks in plant-tempered daub

Fig. 13.7. Daub fragments with finger impressions

Fig. 13.8. Daub fragments with split timber impressions

Fig. 13.9. 'Plate-like' daub fragments with reed impressions in one side

Fig. 13.10. 'Plate-like' daub fragment without reed impressions

Fig. 13.11. 'Plate-like' daub fragment without reed impressions

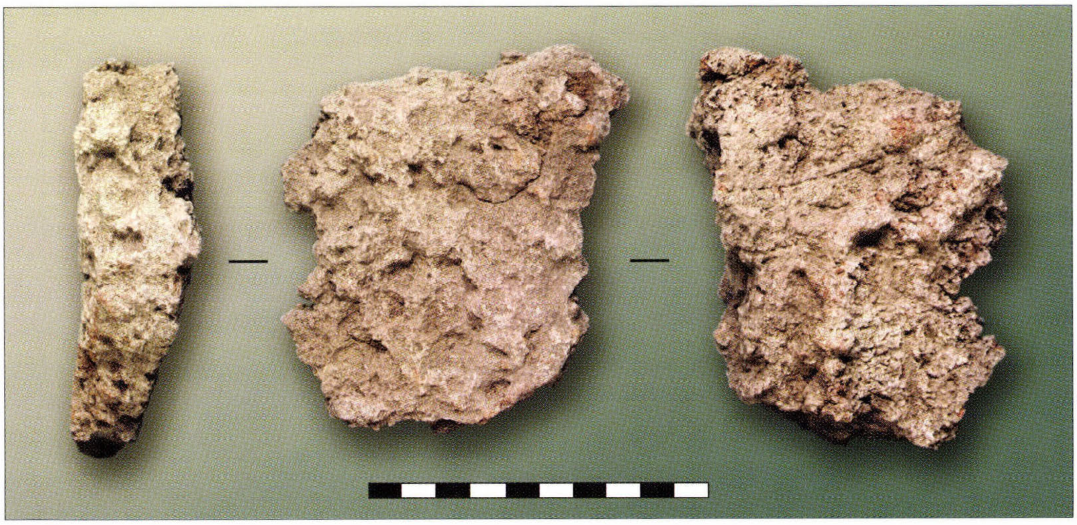


Fig. 13.12. 'Plate-like' daub fragment without reed impressions

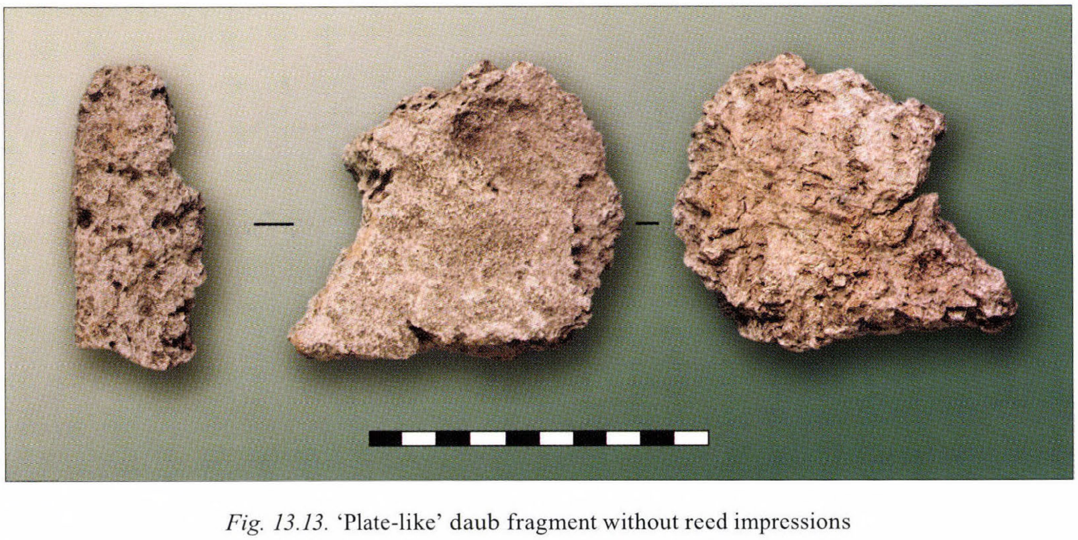


Fig. 13.13. 'Plate-like' daub fragment without reed impressions

Fig. 13.14. 'Plate-like' daub fragment without reed impressions

Fig. 13.15. 'Plate-like' daub fragments without reed impressions

Fig. 13.16. Small daub fragments with angular shape

Fig. 13.17. Small daub fragment with angular shape

Fig. 13.18. Small daub fragment with angular shape

Fig. 13.19. Small daub fragment with angular shape

soil', which may have become a part of the daub either deliberately or by accident (see Macphail, chapter 11, *Table 11.3:* M10780, M14325 and M11884).

It is easy to imagine that, if the soil used for daub manufacture was obtained directly within the settlement, then it may have been easily mixed with topsoil containing humus and cultural deposits in addition to the targeted soil deposit. This soil mixture was then combined with water and reed chaff (see chapter 11). Reed chaff was probably made from the reed leaves and stalks, which were natural by products from the manufacture of reed mats, sheaves and thatches. Comparative samples from other Körös culture settlements are not available, and so we do not know if reeds were often used as chaff. At the late Neolithic site Opovo, of Vinča-Pločnik II date, the soil used for daub manufacture was mixed with chaff of cultural plants (Stevanović 1997, 358–59). Whether the choice of plant (reeds, straw, grasses and so on) was dependent on accessibility (related to, for example, a natural abundance of reed) or whether it is chronologically/culturally dependent cannot be determined at present. However, it is likely that reed chaff will dominate wherever reed was the dominant construction material. In areas, and probably also cultures, where the dominant material used for construction was wattle, branches and soil, chaff was made from other available plants

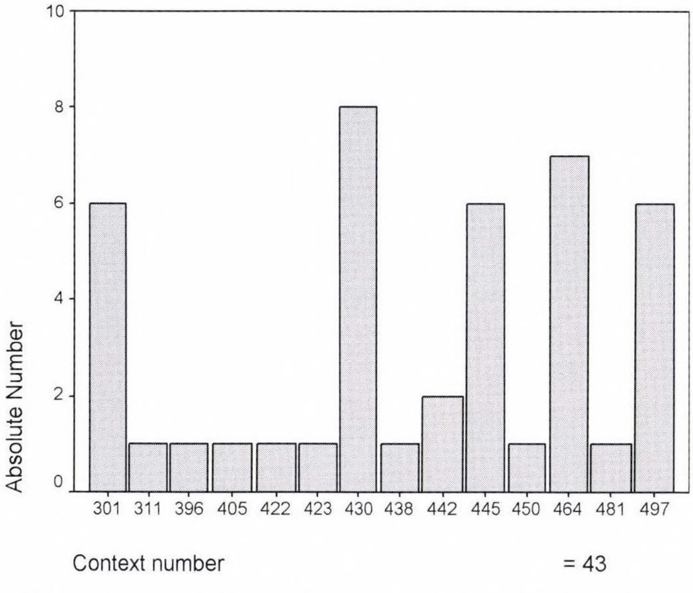


Fig. 13.20. Frequency of vitrified daub fragments in Trench 23B by context

Fig. 13.21. Vitrified daub fragments

Fig. 13.22. Daub fragments without visible plant temper – 'clay plaster'

Fig. 13.23. Upper surface of a 'clay plaster' fragments

Fig. 13.24. Under-surface of a 'clay plaster' fragments

(grasses, and straw from crop plants). It is very likely that in addition to cultural traditions, which undeniably governed the appearance of houses, the choice of building materials was largely the result of locally available building materials. Therefore for example in Italy, fishing villages were predominantly constructed using reeds (Soeder 1964, figs 262 and 287). Fishermen used reeds as the primary building material, since their lifestyle did not allow ample time to acquire sufficient quantities of straw for construction; might agriculturalists growing grain, even if surrounded by reeds, have preferred the use of straw?

In addition to chaff, the daub was also found to contain fine organic matter, probably dung (see below). Cow dung was added to daub in the Early Neolithic settlement of Sofia-Slatina in Bulgaria, for example for the carefully smoothed interior face of a door (Nikolov 1989, 19, 37). It is assumed that dung was added to daub for weatherability and resistance to cracking (see chapter 11). In the Neolithic settlement at Acconia in southern Italy the use of bracken ferns for daub temper was recognised. Bracken ferns, various grasses or sand may be added to the soil to reduce the amount of water needed to puddle it and to diminish the cracking of the daubed walls when they dry (Shaffer 1999, 100, 107).

The daub without visible plant temper. The earth from which it was made contained a relatively high quantity of sand and silt. Contrary to plant-tempered daub, it does not contain any organic elements or phytoliths, which would indicate mixing with humus. Fragments have a beige to light orange colour, and appear to have been less well fired than the daub fragments with plant temper. The smoothed surface of some 'clay plaster' fragments is very light, and resembles a slip. Micromorphological analysis, however, has confirmed the uniformity of the daub without any added slip. There is a high quantity of Potassium (K) in the upper smooth portion of these pieces, which indicates a high concentration of fine organic matter, probably dung. However, it is uncertain whether the dung was added deliberately.

Reed

In addition to daub and wood, the next most important and abundant building material was reed. Reed was available in the immediate vicinity and formed a natural component of the local vegetation (see chapters 5 and 6). It was used widely at Ecsegfalva for the construction of walls, reinforcement of walls, and as an organic additive to daub manufacture. Roofing was very probably made from reeds. It is likely that house furnishings were also made from reeds.

Wood

The foundations of structures were probably made from wood, at least in part. As indicated by the impressions in tempered daub, wood was used in the form of stakes and posts. Split timbers have also been identified. Impressions of thin posts and branches with an average diameter between 5–8 cm have been recognised as well. In some cases wicker and thin branches (with a diameter of 0.5–1.5 cm) may have been used in place of reeds. Wooden posts presumably bore the weight of the walls and the roof. Timbers, branches and thick reed stalks probably served to stabilise the reed frame of the walls.

The splitting of timbers by various techniques is indicated in central Europe, primarily at settlements where post construction predominates (Luley 1992, 47, Abb. 28). In south-east Europe, burnt daub from Neolithic settlements bears traces of split timbers and even planks (Raczky 1987b, 112; Nikolov 1989, 9; Stevanović 1997, 357). It is likely that this construction method was already known in the Early Neolithic of Carpathian Basin. According to Luley, oak is best suited for splitting timbers. However, it is also possible to split maple, fir, larch and spruce pine (Luley 1992, 47).

Indications of some techniques and possible building construction

Wood posts

Two daub pieces have impressions of wooden stakes with a diameter of 10–20 cm *(Fig. 13.25).* A third daub fragment of concave form and a diameter of 32 cm could also represent a post impression *(Fig. 13.25).* The large size may have been the result of deformation by fire. These wood impressions in daub are probably remains of the framework of structures.

Reed matting and reed sheaves

Well preserved daub fragments with reed impressions, often on one side only, indicate that reeds were set in parallel rows resembling sheaves or simple mats. The individual reeds were selected at random. Although large and small reed stalks were put next to one another, together they formed sturdy mats with very small spaces (2 to 8 mm) between individual stalks. Sometimes parallel rows of impressions were identified on both sides of daub fragments. This seems to indicate that some walls had a double reed mat structure or that daub was stuffed between the reed bundles.

Rows of impressions on both sides of the daub usually run in the same direction. However, in some cases it could be confirmed that

Fig. 13.25. Daub fragments with impression of wood stakes and posts

Fig. 13.26. Daub fragment with impressions of a reed matting bounded with fibre cords or reed stalks

Fig. 13.27. Daub fragment with impressions of a possible reed-sheaf

the impressions were arranged horizontally on one side and vertically on the other. Diagonally arranged impressions were seldom observed. It appears that although there was a certain regularity to the arrangement of the reed rows, sometimes the arrangement of reeds strayed from the norm. In isolated cases it could be confirmed that the rows of reed matting were fastened with cords or fixed with some other fastening *(Fig. 13.26).*

A large daub fragment from Ecsegfalva 23 indicates a possible wall construction using reed sheaves or reed mat bundles *(Fig. 13.27).* It does not, however, show any impressions of how these were fixed, as seems to have been found on the wall remains from the buildings at Szolnok-Szanda (Kalicz and Raczky 1980–81, 15).

The plate-like and the angled daub fragments

We do not as yet know the position of the 'plate-like' and the angled plant-tempered daub fragments. The plate-like daub fragments with a thickness up to 4.5 cm yielded hardly any reed impressions. These are present in large quantities.

Since they were not applied to the reed skeleton, it is assumed that these came from a second daub layer applied to the walls and could be connected with wall repairs. According to ethnographic observations, walls were sometimes initially plastered with two or three layers of daub. The second layer of daub plaster was applied on the primary, after it had half-dried (Nikolov 1989, 19). The overlapping layers of daub plaster may also be the result of later repairs.

The small dimensions of the angular fragments with an average thickness of 3 cm make it highly unlikely that a corner of a building is indicated. One third of them have reed impressions, which indicates them to be related to the reed structures. Perhaps some of them came from the daub-reed roof. Other angular daub imprints seems to result from the wood framework or beams and trunks as reinforcements for exterior walls. But the angled daub fragments as well the small 'plate-like' pieces could also represent the remains of some kind of furniture, for example a wall from a storage bin (see *Figs 13.39–40*), a hearth or an oven, which were usually made from plant-tempered daub (Nikolov 1989, 46).

An application of a daub layer as opposed to stamped or compacted earth is indicated, since compacted earth would have resulted in firing of gradually decreasing intensity in the increasing depth of the earth and would not have led to the separation of the burnt layer as observed by us. In this case burning resulted in complete firing right through the thickness of the daub.

The intentional finishing of floors is seen in the Neolithic of the Near East as well as south-east Europe (Kalicz and Raczky 1987a, 18; Nikolov 1989, 9; Luley 1992, 25; Stevanović 1997, 342, fig. 12). For example, 99 per cent of floors and surfaces within buildings at Çatal Höyük were deliberately prepared, which is in contrast to open areas, where no deliberately prepared floors and surfaces have yet been identified (Matthews *et al.* 1996, 304, 312). Sometimes, trodden earth served as the floor. Floors of late Neolithic houses of the Carpathian Basin were also found to have been made from layers of earth, which was sometimes applied to a wooden underlay. It is characteristic that clay floors inside houses were occasionally renewed with a thin layer of clay (Hegedűs and Makkay 1987, 89, 94; Korek 1987, 50; Raczky 1987b, 66; Kalicz and Raczky 1980–81, 14; Kalicz and Raczky 1987b, 112; Nikolov 1989, 9, 43, Abb. 8; Lichter 1993, 43–44; Sklenářová 2003, 17). These thin microlayer remains of separate living floors can be identified with the aid of micromorphology and microstratigraphic analyses. On the basal layer of building ruins of the Early Neolithic settlement from Sofia-Slatina in Bulgaria, clay fragments similar to those in Ecsegfalva have been found, which have been interpreted as house-floors (Nikolov 1989, 37). Their under-surface was also mixed with sand and pebbles. Neolithic ovens sometimes had a similar, although thicker, pebble-sand underlayer to isolate the oven from the ground (Petrasch 1986, 35, 37; Nikolov 1989, 45). But they cannot be compared with what was found in Ecsegfalva. In addition to inhabited structures, several other structures with floors also existed, encompassing granaries, ritual buildings (as temples) and structures with storage functions. The floors in these structures were carefully finished and maintained exceptionally clean. The cross-section of these floors often has a simple structure with a minimal amount of microlayers (Matthews *et al.* 1996, 312–25).

Archaeological excavations and ethnographic research in the Near East and in south-east Europe has indicated that clay was a favoured material used in the manufacture of furnishings such as ovens, hearths, working platforms, storage bins, tables or benches (Mellaart 1975; Raczky 1987a, 72, 77; Nikolov 1989, 43–48; Lichter 1993, 67–69; Özdoğan and Bašgelen 1999). Research in the Tisza and Banat regions from the late Neolithic period and from the Early Neolithic settlement of Sofia-Slatina also supports these findings. The remains of ovens, hearths, bins, benches and clay-plastered working surfaces or altars have been identified in the debris of houses destroyed by fire (Horváth 1987, 40; Kalicz and Raczky 1987a, 19; 1987b, 114–15; Raczky 1987b, 72; Nikolov 1989, 43–48; Lichter 1993, 67–69; Stevanović 1997, 343). Körös culture settlements also bear traces of interior furnishings, although they are rare (Banner 1931a, fig. 9; Selmeczi 1969; Horváth 1989, 86; Makkay 1992, 134).

A wealth of internal furnishings was uncovered in houses of the Herpály and Tisza cultures, for example the rectangular ovens with flat tops at Berettyóújfalu-Herpály. These ovens had a plastered and smoothed base divided into a baking plate and a firing area. The firing plate and the inner and outer wall of the ovens were repeatedly renewed, but not the baking surface. In addition to these ovens, carefully plastered and smoothed oval basins, often dug down to a depth of 1 m into the floor, have also been identified. Most of them contained fine ashy fill. Houses of the Tisza culture, such as at Hódmezővásárhely-Gorzsa and Vésztő-Mágor, yielded rimmed plaster hearths that had been renewed several times. Many houses of the Herpály and Tisza culture contained large clay storage bins. These bins were cylindrical or quadrangular in shape, and were

Fig. 13.28. Daub fragment without visible plant-temper with a reed impression

plastered around a framework of twigs or reeds. They usually stood on the floor, but sometimes were plastered on the floor of houses. Most houses contained clay-plastered areas, and plastered earthen tables or benches (Banner 1931a, 27, fig. 9; Horváth 1987, 40; Hegedűs and Makkay 1987, 89, 94; Kalicz and Raczky 1987a, 19; Kalicz and Raczky 1987b, 114–15). Examples of ovens at Obre from the late Neolithic Butmir group were constructed by applying a layer of clay upon a wooden frame (Petrasch 1986, 38–39).

Since only one side of the 'clay plaster' fragments recovered at Ecsegfalva have a smoothed surface and the undersurface was in contact with the ground, we tended to interpret these finds at first as vestiges of floors, although micromorphological analysis of daub fragments without visible plant temper did not confirm the existence of microlayers (see chapter 11), which would have been characteristic of floors within inhabited houses. Based on information available today, it is also not possible to determine with certitude the intended function(s) the clay plaster. A great part of the 'clay plaster' is well fired and it is possibly not related to the fire which destroyed the structure, but probably connected with a technique to increase the durability of the material during their use. The interpretation of these plaster fragments may be associated with working surfaces or oven bases and even a baking platform akin to an oven, rather than the basement of some structures like storage bins plastered on to the floor. Ethnographic analogies show that all of these features were usually kept clean and many of them were tempered with chaff (Nikolov 1989, 46). In the 'clay plaster' from Ecsegfalva no kind of organic temper was identified. But it is not excluded that the smoothed surface was kept clean, without being renewed. Visible impressions of thick reed stalks (c. 3 cm in diameter) on some 'clay plaster' fragments may indicate a simple reed-daub frame construction or supports for this kind of structure *(Fig. 13.28).*

The appearance of structures and techniques of construction: an idealised description of the possible form of structures at Ecsegfalva

As described and discussed in chapter 9, the examined daub fragments originated predominantly from layers in one area of Trench 23B *(Fig. 13.29),* distributed from the surface to the upper sections of the basal levels. Only a single posthole was discovered and this could not be related to any specific building *(Fig. 13.30).* Its relationship would be better understood, if the adjacent area were to be excavated, since sterile ground has not yet been reached in this area. Traces of post holes are more likely in the lower layers. Nevertheless, it seems to us that the type and quantity of daub fragments indicate the remains of a building or buildings. Indications that buildings stood here in prehistoric times are particularly evident in both the reed and post impressions identified in the daub.

Fig. 13.29. Concentration of well fired daub fragments with impressions in Trench 23B

Fig. 13.30. Remains of a structure with a posthole in Trench 23B (right: a detail of the posthole)

What is the extent of our knowledge? What can we reconstruct?

Dimensions and ground plans of structures

We know very little about the size of the structures identified at Ecsegfalva, since complete foundations were not identified. We know that the remains of burnt daub were concentrated in an exposed area of some 10 by 8–10 m (see chapter 9). On the basis of Körös culture house plans identified at other sites, it is likely that structures usually had a rectangular ground plan.

The walls

On the basis of building material analysis, we can say that most of these structures involved rather light construction. The framework was laid out by vertical wooden posts. These posts were

Fig. 13.31. Recent reed houses with vertical positioned reed rows near the Neolithic settlement of Ecsegfalva

Fig. 13.32. Recent reed house with horizontally positioned reed rows

Fig. 13.33. Daub fragment with marked finger/hands impressions on the even surface

probably placed at regular intervals to form a rectangular shape. The area between the posts was then filled in with reed sheaves or mats bound with fibre cords or other fastenings.

Whether the reed mats or sheaves were positioned vertically or horizontally between the wooden post structures cannot be determined with certainty. Both possibilities have been observed ethnographically. For instance, traditional structures in Italy, which include walls made of straw or reed, were usually placed vertically (Soeder 1964, 104–7). The vertical placement of reed sheaving/matting is slightly more stable if it is complemented by sufficient horizontal reinforcement. More recent reed houses, built in the vicinity of the Neolithic settlement of Ecsegfalva, usually have also vertically positioned reed rows *(Fig. 13.31).* In other recent cases they were placed horizontally, which would have held the daub wall in place (*Fig. 13.32).*

Different daub impressions from Ecsegfalva indicate that the reed skeletons of walls were reinforced with thin branches, thick reed stalks, and split posts. Sometimes it was possible to identify two overlapping daub layers, which indicate also reinforcement or repairs of the walls. This is related to fragments of daub without visible reed impressions, which sometimes have one smoothed side, similar to exterior wall surfaces. Occasionally they have marked finger impressions *(Fig. 13.33)* and one or more deep grooves made by other means *(Fig. 13.34)* indicating that wall surfaces have been regulated, smoothed and decorated with the hands as well as with tools. Some of the surfaces are not smoothed; instead they have parallel fine impressions (*Figs 13.8* and *13.35–36*), which could have come from the impression of halved trunks or branches placed on the wall to reinforce the reed-daub walls. Similar constructions can be seen in recent reed buildings in the area of Ecsegfalva, which are used as animal shelters *(Fig. 13.37)*.

The thickness of the walls cannot be estimated at present, since no complete wall segments could be found. Some wall daub fragments are, however, very thick: up to 20 cm *(Fig. 13.38)*. Thus it is conjectured that at least some walls were rather thick.

Limited information is available regarding the materials used in the construction of walls in the Balkans and Carpathian Basin. It is often assumed that the walls were equipped with branches woven on to a wooden construction (Kalicz and Raczky 1987a, 113; Raczky 1987a, 72; Nikolov 1989, 32–38; Lichter 1993, 41–50; Stevanović 1997; Hiller 2001; Bánffy 2004). Researchers seldom mention reeds. Often it is assumed that walls were made from woven wicker and plastered with daub (Horváth 1989, 86). However, where portions of walls have been preserved, as at Szolnok-Szanda where fire preserved some wall fragments, construction methods are similar to those identified at Ecsegfalva 23B, confirming that the space between vertical posts was filled with reed bundles and plastered with daub; the entire structure was then reinforced with transverse joints (Kalicz and Raczky 1981, 15). At the site of Hódmezővásárhely-Kotacpart constructions using reeds have also been envisaged (Banner 1942, 17). Reeds are most

Fig. 13.34. Daub fragments with grooves impressions on the even surface

Fig. 13.35. Daub fragments with split timber impressions

Fig. 13.36. Daub fragment with fine parallel (wood?) impressions

Fig. 13.37. Recent houses with reed walls reinforced with trunks and branches near the Neolithic settlement of Ecsegfalva

often associated with roofing and only rarely considered in wall construction (Banner 1942, 17; Horváth 1989, 86; Stevanović 1997, 337). Otherwise information regarding the use of reeds in the Körös culture is ambiguous.

The use of reeds in construction is indicated at the early site of Nea Nikomedia in northern Greece. Robert Rodden indicated that the construction of houses involved the use of small oak posts which were 90–120 cm apart and sunk into the ground (sometimes up to a depth of 1 m). The area between the posts was then filled vertically with reed bundles, which formed the core of the walls. Finally the interior walls were plastered with organically tempered daub, while the exterior walls were plastered with white clay (Rodden 1989, 103).

At Ecsegfalva none of the daub yielded clear impressions of interwoven wattle. In contrast, wattle has been presumed in most larger Körös culture structures (Horváth 1989, 86). Wattle

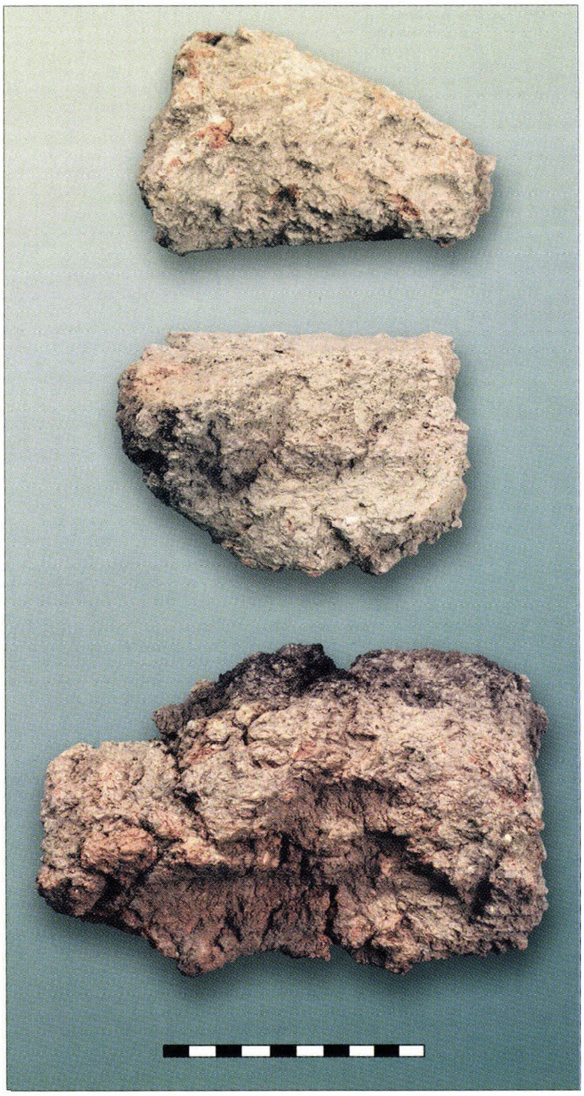


Fig. 13.38. The thickness of some daub wall fragments

Fig. 13.39. Storage bins in a cave building in Hasankeyf in northeastern Turkey (photo by I. Mateiciucová)

Fig. 13.40. The making of storage bins (Nippa 1991, Abb. 60)

walls are also envisaged in better preserved remains of structures dated to the late Neolithic in Carpathian Basin (Raczky 1987a, 72).

And what about the roof?

The relatively light construction of the walls suggests that the roof of Ecsegfalva building(s) must also have been rather light. Since we have only found impressions of reeds and wood, we presume that reeds in the form of reed sheaving (possibly even thatch) were used to cover the roof, as examples from ethnography illustrate (Coudart 1998, 70, fig. 76). We do not know the shape of the roof, but based on the model found at the Körös culture site of Röszke-Lúdvár (Trogmayer 1966, 238, fig. 2) we presume that the roof was gabled, which would have allowed better run-off of both water and snow. On the basis of post holes of supporting posts and other clay house models, a gable roof is assumed for most inhabited structures throughout central and south-east Europe (Schlette 1958; Lichter 1993, 61–63).

We suggest that the construction of roofs at Ecsegfalva may also have been related to the so-called clay 'net-sinkers'. These are often oval with an average diameter of 7–10 cm and have one central perforation, and frequently exterior grooves; those are sometimes diagonal, instead of horizontal. These items have a particular concentration within the area of daub fragments in Trench B at Ecsegfalva 23. The distribution and unusual perforations of these items raise the possibility that they may have functioned as something other than loom weights or net-sinkers. It is conceivable that they were attached to the cords of nets placed over the reed roof in order to secure it better against the wind. These objects are described and discussed in chapter 28.

On all these grounds, we tentatively offer reconstruction drawings of how structures may have appeared at Ecsegfalva 23 in the early sixth millennium cal BC *(Figs 13.41–42)*. The uncertainties hardly need stressing again.

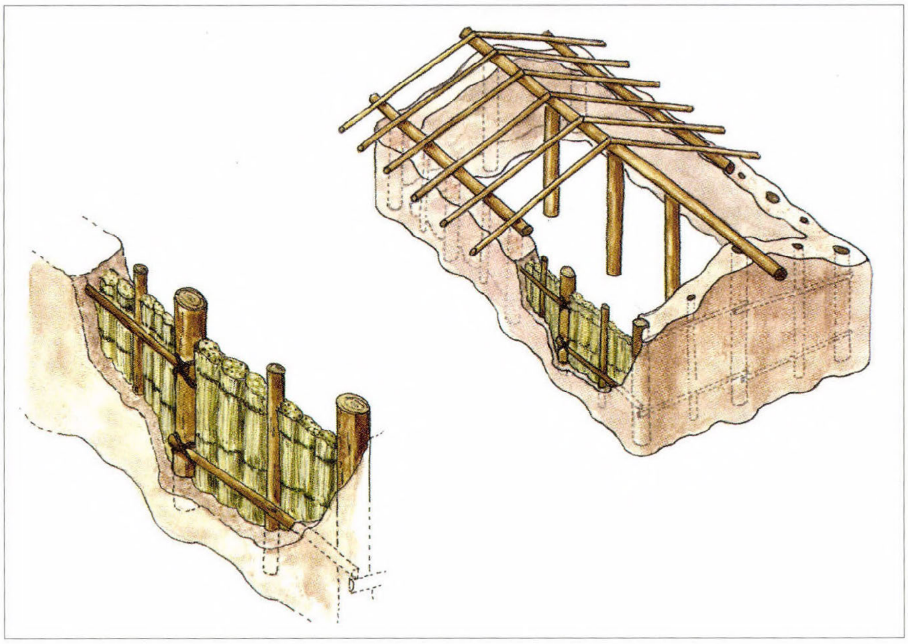


Fig. 13.41. Ideal reconstruction of the structure from Ecsegfalva 23
(drawn by D. Helbling and I. Mateiciucová)

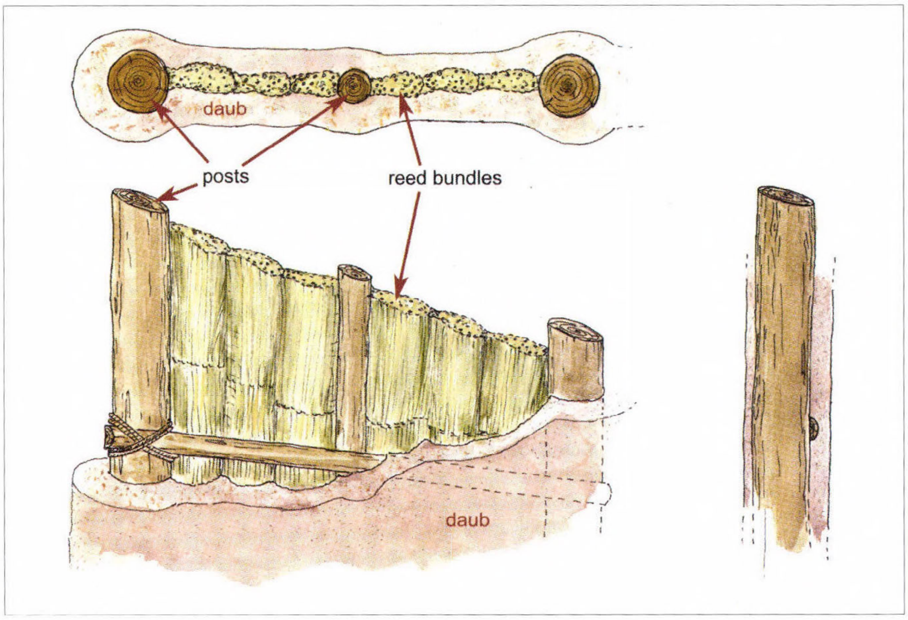


Fig. 13.42. The wall detail in the ideal reconstruction of the structure from Ecsegfalva 23
(drawn by D. Helbling and I. Mateiciucová)

Internal furnishings

We are not able to elaborate on the interior furnishings of structures at this time. Fragments of 'clay plaster' and 'plate-like' and even the angled pieces may well be the remains of some internal furnishings (see above).

When were the structures built?

The best time to get superior wood for construction is the autumn and winter (from October to January) when the trees contain much less water (Nikolov 1989, 32–34). According to ethnographic observations the best period to cut down the reed is also the winter period, when the water in the stalks is frozen and the cutting is much easier (http://members.lycos.co.uk/tatcher/materia.htm).

This suggests that the collecting and preparing of the building material as wood and probably also reed may have begun in the autumn or during the winter to obtain the best quality. Nevertheless trunks, branches and timbers of trees as well reed stalks could stand a long time in the settlement or in the surroundings before being used for the construction of buildings. Without research which could give precise results, it is not possible to determine the season when the wood-reed-daub structures were really built in Ecsegfalva.

The function and stability of structures

In the same way we cannot determine the function(s) of the identified structures at this time. However, the concentration of many small finds, such as sherds of ceramic vessels, clay weights, animal bones, shells, stone and bone tools may indicate buildings with a domestic function.

How long these structures stood, how stable they were, or how often they were repaired, are questions which cannot easily be answered by the current analyses. Based on building materials used, it can be assumed that the buildings were not very resilient. As indicated by reed impressions, the reed stalks used in the construction of walls and probably also of the roof were on average 1 cm thick (most between 0.5 and 1.4 cm) *(Figs 13.26–27).* In addition to these thin stalks, occasionally impressions of stalks measuring 3.5 or 6.5 cm have been identified, which similar in size to those of wood (branches and split timbers). The diameters of the wood stakes are between 10 and 20 cm *(Fig. 13.25).* This means that the structures had to be repaired from time to time. Nevertheless, modern experiments show that the durability of wooden daub structures depends more on the method of building rather than on the building materials used.

One structure or several?

There remains no doubt that some kind of structure(s) stood within the area of Trench B at Ecsegfalva 23. Whether the vestiges represent one or more structures remains uncertain. Radiocarbon dates (see chapter 10) suggest a succession of buildings, which is today reduced to a 30 cm cultural layer, and has been dated to a span of around 100 years. It seems more likely that several individual structures were built in this area. The remains of the upper buildings are more visible to us today, as indicated by the larger 'clay-plaster' fragments preserved in the upper layers.

Structures destroyed by fire

Some vitrified daub fragments together with a big quantity of well fired daub was distributed from the upper to the lower excavated contexts in the northern part of Trench B in Ecsegfalva 23 *(Figs 13.20–21).* This fact indicates that at least one of the structures was destroyed by fire. But the duration and intensity of the fire or fires seem to have varied in the different parts of the building(s), since daub fragments show different degrees of burning in their hardness and colour.

Before going on with this question as concerns Ecsegfalva 23, we will briefly review the state of knowledge of this subject in the Neolithic Balkans and the Carpathian Basin.

Layers of burnt daub in association with burnt structures have been identified at many Körös culture settlements, for example at Endrőd, Hódmezővásárhely, Szajol, Szanda and Tiszajenő (Kalicz and Raczky 1980–81, 14–16; Makkay 1992, 130; Kalicz 1998, 259). Newly identified architectural remains at the Mezőkövesd site, which dates to the Szatmár culture (chronologically between the Körös culture and the AVK), also suggest that the houses were destroyed by fire (Kalicz and Koós 2002, 46). Unfortunately, information regarding house burning is not available from the AVK culture (Kalicz and Makkay 1977, 72–73; Šiška 1998, 269). Traditionally, the question of how and why structures were destroyed by fire has received limited attention. The issue of house burning began to be drawn to wider attention in the 1990s when Ruth Tringham and Mira Stevanović studied a variety of structures burnt in the Neolithic of south-east Europe (Tringham and Krstić 1990; Tringham 1991; 2000b, 2005; Stevanović 1997; Stevanović and Tringham 1997). During the course of their study of late Neolithic architecture from the Vinča culture at Opovo in the Yugoslavian Banat, they attempted to determine whether the fire that destroyed many of the houses was started deliberately or by accident. Both researchers have suggested that house fires at Opovo were started deliberately and that it was also a common practice in the Middle to Late Neolithic/Early Eneolithic period in south-east Europe, especially in the late period of the Vinča culture (Stevanović and Tringham 1997, 200, 207, fig. 1). The earliest evidence of intentional house burning comes from the Early Neolithic Karanovo I tell in Bulgaria. Remains of houses preserved by fire have also been identified in the late phase of the Starčevo culture (Stevanović 1997, 337; Stevanović and Tringham 1997, 198, 207, fig. 1).

Subjects such as the continuity of settlement, the abandonment of rooms and the deliberateness of house burning at the Neolithic site of Çatal Höyük in Anatolia have been main research questions of the research project 'BACH' under the direction of Stevanović and Tringham since 1997 (Tringham 2000b, 126, 127). Stevanović (1997, 337–38) has suggested that the origin of house burning coincides with the onset of the Neolithic in the Balkans and the Carpathian Basin.

The conclusions reached by Stevanović and Tringham about the hypothesis of deliberate house burning at Opovo are as follows (Tringham 1991, 122–23; Stevanović 1997, 381–82):

a) the temperatures reached during house burning were much too high to have been achieved merely by the ignition of the wooden construction;
b) the fire path indicates several ignition points within a single house;
c) the fire path shows that ignition did not start at the roof but at the floor level;
d) the houses were pulled down in an organised and strategic way;
e) the houses were not used after firing;
f) no bodies were found inside the houses, nor were house contents; and animal skeletons were not found inside or nearby the structures; all indicating intentional fires that had not been set as acts of aggression; and
g) the houses were burnt individually, as indicated by the lack of burned materials in the areas between houses.

What led to the deliberate destruction of a house by burning?

There are many reasons why houses might have been burnt deliberately in separate fires, for example, to eradicate pests, insects, or disease, or for functional reasons, such as to salvage the daub for new walls, or even to improve the protective properties of buildings by preliminary firings of daubed walls (Nikolov 1989, 40–42; Tringham 1991, 123; 2000b; 2005; Shaffer 1993, 73; Stevanović 1997, 386). Prophylactic firing was suggested for Slatina (Nikolov 1989, 40–42), and the practice is evidently common in China (Richard Macphail, *pers. comm.*). Tringham and Stevanović have tended to see house burning as a ritualised and deliberate act, carried out with the death of the household authority figure, as a symbolic end of the household cycle (Tringham 1991, 123; 2005; Stevanović and Tringham 1997, 200). Burning of one or more structures at the time of abandonment in relation to the death of a person is widely known ethnographically, for example amongst the Pueblo Indians of south-west North America (Montgomery 1993, 161).

Two burials were found at the Körös culture settlements Szajol-Felsőföldek and Szolnok-Szanda-Tenyősziget beneath the burnt remains of house floors (Raczky 1983a, 5). Could these remains be related with burial rituals in a domestic context and be associated with intentional firing? Possible connections between burial and fire in domestic assemblages have been considered by Peter Akkermans and Marc Verhoeven in northern Syria. In the Transitional-Halaf horizon (level 6, building V, room 7) of the Late Neolithic Tell Sabi Abyad were found the skeletons of two adults, who according to the stratigraphy might have fallen in with the roof. On this roof were also found large egg-shaped objects made of clay. The two skeletons were completely crushed and burnt. This seemed to be related to the destruction of the village by fire, since several other buildings and many of their objects (stone and bone tools, ceramics, figurines, seals and grain) were heavily damaged by fire. In this case the dead corpses of the two people from building V could already have been on the roof, for defleshing by exposure before final interment, at the time of destruction of the village by fire, since a similar custom was also observed in Çatal Höyük in Anatolia (Akkermans and Verhoeven 1995, 16). The discovery of the horns of wild sheep and bones of other probably wild animals inside the clay objects suggests an individual deliberately set fire for mortuary ritual (Verhoeven 1999, 60–64, 220–29). Although the reason for the massive fire at Tell Sabi Abyad is still unknown, the burial and accompanying goods may not only indicate a mortuary rite of passage, but could also possibly relate to the abandonment of the 'burnt village', as Tell Sabi Abyad is now known (Verhoeven 1999, 60, 224).

According to Stevanović, house burning and collapse were an organised and strategic effort of house destruction in order to completely 'seal off' the structure from possible future utilitarian use. After this transformation, houses may have acquired a new non-utilitarian function, such as ensuring the continuation of the ancestral line in one place. The symbolic continuation of place was established when older features were used as the foundation for a new house, with the symbolic incorporation of an old house into a new one (Stevanović 1997, 385, 388). In the same way, Stevanović and Tringham (Tringham 1991, 123; Stevanović and Tringham 1997, 200–201) propose that the burnt house remains at Opovo also reflect a continuity of land use and possibly land ownership.

What can we say about the destruction of structures by fire at Ecsegfalva?

It is clear from the above that a great range of explanations is possible, from everyday accident to planned, deliberate destruction. As *Fig. 13.3* shows, besides the great quantities of well fired daub predominantly in intense orange to red colours, some vitrified daub fragments with an intense orange to black colour were found at Ecsegfalva 23. The irreversible conversion of daub crystals during the burning process requires temperatures (over a suitable duration) of over 700°C (Leineweber 1995, 189). To turn clay into slag requires temperatures of about 1000°C over a longer time (Leineweber 1999, 37). Scientific analysis of ceramics and clays from the Iron Age and Roman period settlement at Boomburg-Hatzum, in northern Germany, indicates that local clay blows up by 1100°C. But when the burning temperature went up quite fast, clay can vitrify at lower temperatures (Hennicke and Rossmanith 1982, 97). When clay does not contain fluxes, it is possible to reduce its melt temperature considerably (Kaltofen 1998, 180). The same results were produced by the presence of sodium salt and 'Kalisalz', common in sea water, during the experiment with the ceramic oven from Weddinghusen in Germany (Arnold 1990, 353).

However, according to Stevanović and Tringham, the presence of vitrified daub is a significant indication of deliberate house burning, since the heat required for its creation could not have been achieved merely by ignition of a house. Although building materials from wood-reed-daub constructions were flammable (especially the roof), they could not have sustained the flame enough to reach the temperatures required and it must have been sustained with additional fuel placed alongside these structures (Tringham 1991, 122–23; Stevanović 1997, 371–73, 381–85).

Others have supported this suggestion. Strutzberg (2004, 90) confirms that temperatures between 700°C and 1000°C from a burning light roof could be reached very quickly but not be sustained for more than half an hour; within this time or some minutes later, the roof burnt and collapsed. But different results came from the house burning experiment at Moravatal in Serbia. Here roof beams began to flame 50 minutes after the outbreak of the fire and the greater part of the roof first failed only three hours later (Bankoff und Winter 1979, 8).

The experimental house burning in the Germanic village of Klein Köris in Germany showed once more how differently a light daub construction could burn. After the burning of the wood-framed and daub-plastered wall, both central wooden posts remained smouldering for a long time. After six hours the temperature by the eastern central post was still 520°C, and was probably much higher before that (the highest registered temperature there was 800°C). The reason for this was a combination of a lack of oxygen on both sides of the wall, and a chimney effect formed by the central posts. The constant draught moved slowly from the base to the top of the posts over a long time (Strutzberg 2004, 92). Here the high temperatures in contrast to the burning material were accountable for the developing of the firing process. In other cases, firing temperatures were raised considerably by the great quantity of burning material in the buildings or stored there, such as reed thatch from the roof, straw and grains (Strutzberg 2004, 91).

From practical military experience in the Indo-Afghan borderlands, Colonel Gordon reported that wooden, reed or daub and wattle houses, and houses with thatched roofs, could be fired without difficulty, but that houses with flat mud roofs could not have been fired without extra fuel (Gordon 1953, 151).

Examples from experimental archaeology thus indicate how wood-reed-daub domestic structures can conflagrate in a variety of ways and how difficult the reconstruction of burn catastrophes from archaeological remains really is. A simple transfer of conditions from experimental archaeology to the archaeological situation is not recommended. Numerous factors, such as the kind of materials in question and their qualities, seasonal weather conditions (especially in the heat of summer), burn circumstances, or differential temperatures in different parts of buildings, would be conducive under singular conditions to a diversity of outcomes.

Despite the uncertainty over how structures burned in Ecsegfalva 23, we can be quite sure from the large quantity of well fired daub that a great fire or fires did take place in the area uncovered in Trench B. The 121.5 kg of the material studied comprised probably about a third of the daub collected during excavation (which did not reach sterile ground in the North and West Extensions). Recent experiments have shown how difficult the creation of fired daub under low burn temperatures can be. In these cases, after only some weeks the daub begins to crumble. Good daub preservation was obtained by temperatures around 700°C to 900°C (Strutzberg 2004, 93–95).

In the present state of knowledge, it cannot be determined whether the fire in the area uncovered by Trench B in Ecsegfalva 23 was limited to only one feature, or whether it simultaneously destroyed multiple structures. Furthermore, the burnt daub was concentrated in a single area. The stratigraphy in the relatively small area sampled allows for a succession of buildings over the period of occupation. Only a few of the artefacts or bones recovered from Ecsegfalva bore traces of fire. May this fact mean that the interior of some of these structures were empty before the fire began? Or may this indicate that just one of the successive structures were burned?

Were the structures at Ecsegfalva deliberately destroyed by burning? Does this tradition date back to the Early Neolithic? Can the present state of knowledge address these questions?

Although at present there is insufficient knowledge to answer the question of whether the tradition of controlled and deliberate house burning was customary within the Körös culture, some facts may tend to support this hypothesis by the following arguments:

a) according to the literature, structures on Körös culture settlements were frequently destroyed by fire;
b) the fire in the area uncovered in Trench B at Ecsegfalva 23 (and possibly also in other Körös culture settlements) attained temperatures over 700°C, since durable daub could not otherwise be preserved;
c) the burning of structures at Ecsegfalva may have reached in some places around or over 1000°C. Whether these high temperatures would have been generated by deliberate addition of fuel in one or more parts of the structure(s) to increase the intensity of conflagration remains uncertain.

Both comparative examples and the observations which we have made suggest that there was something more complex going on than simply or only the accidental combustion of settlement buildings. These points may constitute the starting point for future research on the destruction of Körös culture settlements by fire.

Conclusion

The interdisciplinary research project at Ecsegfalva aimed to reconstruct the lifestyle of the Early Neolithic Körös culture. The research reported in this chapter comprised Körös culture housing in terms of adaptation to the local environment, the construction methods used to build them, the function of identified structures, and the character of and reason for destruction of structures. Questions asked at the onset of research were answered only partially and have inspired a series of additional questions. Nevertheless it was possible to acquire a series of important facts and to present novel solutions to some questions of Körös culture structures. This contribution should serve as a point of departure for additional architectural studies at Ecsegfalva, and on the Körös culture in general.

Main results of this study

Trench B at Ecsegfalva 23 yielded substantial deposits of burnt daub. The daub fragments seem to represent the remains of several individual structures. Many small finds were also uncovered in this area, such as sherds of ceramic vessels, clay weights, animal bones and stone tools. Due to the massive quantities of recovered daub, only a sample could be thoroughly examined in the scope of this study.

Two types of daub were identified. The majority of the daub was made with organic temper (reed chaff). The plant-tempered daub fragments comprised fragments of building wall plaster indicating an internal structure of wooden posts and bound reed mats or sheaves. In addition to plant-tempered daub, daub fragments without visible plant temper were also identified.

Due to the small area excavated, the plans and size of structures at Ecsegfalva remain unknown. No post holes were identified that could be securely related to a specific structure. The function of structures at Ecsegfalva also remains unknown, although the concentration of artefacts in their vicinity is suggestive of a domestic function.

The interdisciplinary research project at Ecsegfalva did, however, permit the acquisition of a variety of data regarding building construction. The buildings at Ecsegfalva 23B were made from three main types of materials: wood, reed and clay. All these materials were available in the immediate vicinity, and their use indicates adaptation to the local environment.

Analysis of impressions preserved in burnt daub indicates that the structures had a lightweight post construction, with the area between posts reinforced by reed mats and sheaves plastered with daub. When timber posts were used, they usually had an average diameter between 10–20 cm, in addition to thin posts and branches with an average diameter between 5–8 cm. Split timbers were also identified. Stronger posts were probably used to support the weight of the walls and the roof. Smaller timber and split timber were used to reinforce the reed wall skeleton. The reed frame consisted of reed sheaves or reed mat bundles, and possibly also mats filled in the area between posts. Whether the mats or sheaves were positioned horizontally or vertically between the posts cannot be determined at the present. The vertical placement of reed matting or straw has been observed ethnographically, and stabilises the structure when complemented with sufficient horizontal reinforcement, like branches, thick reed stalks and split posts. Finally, the walls were plastered with daub, perharps from both sides. In some cases they were built with more than one plaster layer or repaired from time to time, as indicated by multiple daub layers.

According to the model found at the Röszke-Lúdvár Körös site, the roof was probably gabled and made from reeds (Trogmayer 1966, 235–40). Roof construction at Ecsegfalva may be connected with the presence of so-called clay 'net sinkers' recovered from the site. These may have been attached to the cords of a net and placed over the reed roof in order to keep it in place and protect it from the wind.

Structures built in this way probably required frequent repairs. Current knowledge does not permit further conclusions regarding the structures' stability. However, the wall width probably ranged between 20–30 cm. If these structures served as dwellings, it is likely that they were solid enough to be inhabited virtually year-round. The construction of such a house was probably relatively straightforward in a technical sense, but would have required the cooperation of family members, and the community. This in itself would have made the structure 'worthwhile'. To obtain the best quality materials, people may have begun the collection and preparation of wood and probably also reeds in the autumn or during the winter.

Indications of architecture in the Körös culture are rare. Detailed illustrations of findings which could complete and complement written descriptions are very rare. The literature seldom refers to the methods and materials used in building construction. It is likely that the thorough research of architecture at other Körös culture settlements will also reveal the frequent use of reed in building.

We know very little about the interiors of Körös culture structures. Fragments of 'clay plaster', made from very fine silt and sandy alluvial deposits at Ecsegfalva, displayed two opposing surfaces. The smoothed upper surface has a pale colour and resembles a slip, suggestive of these being remains of floors. However, micromorphological analysis has confirmed the uniformity of the daub without any added slip, which counters their interpretation as floors. On the other hand, micromorphological analysis showed high quantity levels of potassium in this smooth surface, indicating a high concentration of fine organic matter, probably dung. These pieces may well be the remains of internal furnishings such as ovens, baking plates of an oven, working surfaces, and so on. The best preserved of these structures were identified in the uppermost horizon of Ecsegfalva 23B and probably belonged to an eroded structure. Plate-like daub fragments together with angled daub fragments may also be remains of some internal furnishing, like storage bins, benches and tables or walls of ovens.

Buildings identified at Ecsegfalva appear to have been destroyed by fire. Remains of burnt structures are common in other Körös culture settlements, for example at Hódmezővásárhely, Tiszajenő, Szajol, Szanda and Endrőd (Kalicz 1998, 259). The presence of vitrified daub fragments amongst the burnt daub remains recovered from Ecsegfalva 23B indicates that the structures were destroyed as a result of extreme heat, which could exceed 1000°C. This aspect introduces other elements than the common archaeological interpretation of accidental burning of domestic structures. The possibility of intentional burning of buildings and structures must also be considered and discussed. Deliberate burning of buildings in the Balkans and the Carpathian Basin was common in the Middle Neolithic, and especially in the Late Neolithic/Early Eneolithic. The earliest indications of house burning come from the Early Neolithic in Bulgaria as well as from the Starčevo culture. Were the buildings at Ecsegfalva and other Körös culture settlements burnt deliberately as well? Did deliberate burning relate to continuous settlement in one place, or was it part of a cycle of occupation? These questions are considered further in the concluding chapter.

Acknowledgements

We would like to sincerely thank Alasdair Whittle for the invitation to work on the daub fragments and for inviting us to take part in the Ecsegfalva Workshop held at the University of Cardiff in May 2003. Finally, we would also like to thank Petra Málková and Ernest Jilg for translating, and Alasdair Whittle for correcting the text, and for reading and commenting on the final draft of this paper.

Chapter 14

MAMMALIAN BONE

László Bartosiewicz

Introduction

Attitudes toward the natural environment and the wild as well as domestic fauna are of help in reconstructing the emergence of Neolithic lifeways in south-eastern Hungary. The sites of Ecsegfalva 18 and 23 are of key importance in understanding details of the phenomena outlined in the pioneering paper by Sándor Bökönyi (1992a), who studied the large animal bone assemblage from Endrőd 119, a neighbouring Körös culture settlement, located in largely the same geographical setting as Ecsegfalva on the Great Hungarian Plain.

Pleistocene and Early Holocene deposits of wind-blown loess, structured only by the successive meandering of active streambeds across the Great Plain created a flat landscape well suited for cultivation. In this section of the Carpathian Basin, therefore, early agricultural achievements of the Near East reached the margins of the European deciduous forest belt. In classical phytogeographic terms, in addition to the almost ubiquitous *Temperate zone 2* vegetation, the *Pannonian-Pontic-Anatolian zone 1*, or 'forest steppe/steppe zone' is represented in the central Great Hungarian Plain, reminiscent of the South Russian steppe. Such patches of Holocene vegetation in Pannonicum already attracted considerable scholarly attention in the early twentieth century (Tuzson 1913; Soó 1940, 1–4).

It has been hotly debated whether 'neolithisation' in this natural environment spread through migration and acculturation of peoples or rather by the diffusion of styles and ideas. The most important questions of neolithisation in this region, therefore, revolve around the degree of mobility of and continuity between prehistoric human populations of the period. Mammalian remains recovered from Ecsegfalva 23 contribute details to solving various aspects of this problem.

In addition, the composition of the fauna brings into focus the complex interplay between culturally determined attitudes toward animals versus the tolerance of these herds toward different, more stressful living circumstances. The choices made by Neolithic groups in terms of hunting and stock raising were not based on maximising the potentials of the new, more humid environment but rather on maintaining social structures and subsistence patterns established earlier in environments more conducive to sheep herding.

Material

Owing to the rather good preservation of the material from the Neolithic settlement of Ecsegfalva, over 20,000 datable animal remains could be identified, mostly to species, but at least to family level. Six thousand of these originated from mammals. However, due to a combination of high fragmentation and sieving that favoured the recovery of the resulting, often very small fragments, the number of identifiable specimens (NISP) from mammals make up only 40% of

Table 14.1. The summary table of mammalian remains recovered by hand-collection and 4 mm dry sieving from sites 18A and 23 at Ecsegfalva

Trench	23A	23B	23C	23 total	18A
Total NISP	**211**	**5422**	**319**	**5952**	**26**
Total weight, g	2004.0	33142.0	3153.0	38299.0	296.0
Mean weight, g	9.5	6.1	9.9	6.4	11.8
Non-identifiable, n	105	8859	233	9197	15
Non-identifiable weight, g	139.5	3710.3	207.3	4057.1	8.8
Non-identifiable mean weight, g	1.3	0.4	0.9	0.4	0.6

the assemblage analysed. It is this portion of the material that could be used in reconstructing ancient meat diets, and indirectly, animal keeping in various time periods at the site. Animal remains were brought to light at sites 18 and 23 at Ecsegfalva, the latter being represented by three Trenches, A, B, and C. Of these, Trench 23B contributed the majority of zoological finds to the overall assemblage.

The detailed taxonomic and anatomical distributions of the material (NISP) is listed by trenches in *Tables 14.I to 14.IV of the Appendix.* Rodent bones are summarised separately in *Table 14.V.* Bone measurements, following the standard by von den Driesch (1976) are listed in *Appendix Table 14.VI.*

On the basis of species frequencies listed in these tables, the Ecsegfalva 23 animal bone assemblage may be compared to other Körös culture samples in the region. Although sample size directly affects the interpretation of ratio values, keeping differences in sample size (NISP) in mind, percentages offer an easily interpretable, conventional view of relative species frequencies. Most importantly, domestic mammals included in *Fig. 14.1* (based on Bökönyi 1964; 1974; 1981; 1992a; 1989; Vörös 1980) make up some 95% of the identifiable animal remains in large, i.e. statistically more representative Körös culture assemblages (NISP > 1000).

In addition to the number of bone fragments, the weight of each piece was also taken in an effort to compensate for extreme NISP values caused by differential fragmentation. The taxonomic distribution of animal remains by weight (g) and NISP in the pooled material from Ecsegfalva is shown in *Fig. 14.2.* Evidently, the two parameters shown in this graph are closely correlated with each other ($r = 0.692$; $P \leq 0.01$). It is rather the discrepancies between these two trends that are worth noting. Sheep and goat (Caprinae subfamily) as well as cattle, the three species making up over 90% of the bone fragments, represent only a smaller percent of the pooled assemblage in terms of bone weights. While small, fragmented caprine bones weigh rela-

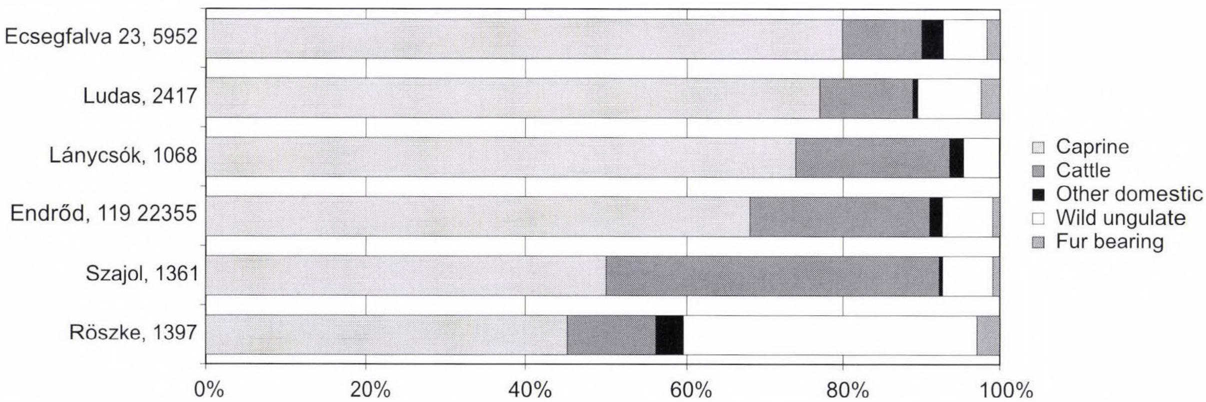


Fig. 14.1. Characteristic percentual contributions of various taxa to overall NISP at Körös culture settlements

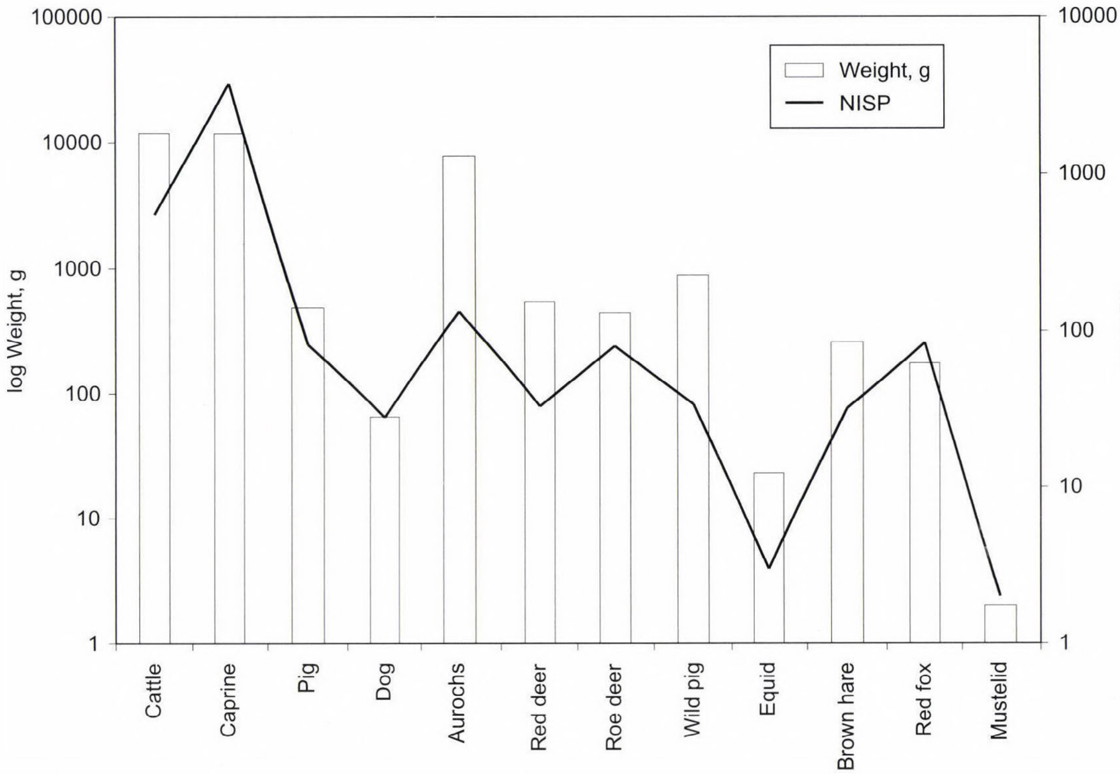


Fig. 14.2. The relationship between the weight and number of identifiable bone specimens by mammalian taxa in the pooled assemblage from Ecsegfalva

tively little, the remains of large game found in almost insignificant numbers, especially those of aurochs, add up to a considerable component when bone weights are considered.

Results

Preservation and modifications

As is usual with prehistoric assemblages from this part of Hungary, the animal bones were heavily fragmented and relatively evenly spread over the site's excavated surface. It may be hypothesised therefore that, in addition to butchering, secondary fragmentation resulting from trampling, cryoturbation and other processes (see also Macphail, chapter 11) also contributed to the poor state of bones. The remains of large mammals (wild and domestic cattle, red deer, wild boar, wild ass) averaged 19.1 g (mean fragment length = 64.8 mm). Bones from smaller mammals (sheep, goat, domestic pig, roe deer, hare, dog and others; (not including rodents) averaged only 3.2 g (mean fragment length = 43.5 mm).

High fragmentation is characterised in practical terms by the number of bones measurable in full length. These numbered 13 in the case of domestic cattle. All but one of them were, however, short bones: tarsalia and phalanges. At the nearby Körös culture site of Endrőd 119, Bökönyi (1992a, 196–7) found a total of 15 intact, i. e. measurable long bones among the total of 5139 cattle remains. The 57 fully measurable bones from sheep and goat at Ecsegfalva 23 included only 12 complete long bones, as opposed to the 170 such specimens found among the 15,357 sheep remains at Endrőd 119 (Bökönyi 1992a, 196–7).

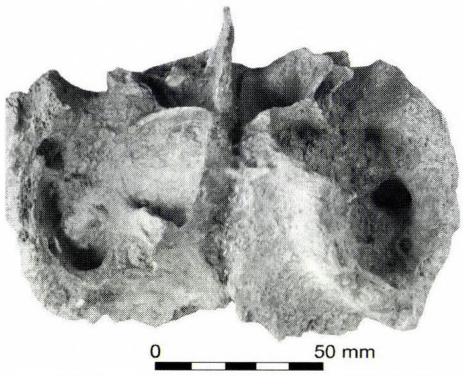


Fig. 14.3. Frontal view of a goat neurocranium with remains of the horn cores and sinuses exposed

Table 14.2. Degrees of fire exposure on the bones of large and small mammals

	Large mammal	Small mammal	Total
Burnt	10	33	**43**
Carbonised	27	35	**62**
Calcined	23	65	**88**
Total	**60**	**133**	**193**

No fully preserved skulls came to light at Ecsegfalva 23. Under these circumstances a goat frontal bone with the remains of both horn cores on it *(Fig. 14.3)*, may be considered a 'trophy', although its prehistoric meaning remains unknown.

In light of the scarcity of lithic raw materials in the natural environment, it is not surprising that only very few cut marks could be identified. The 8 cases recorded included a single cutmark on the diaphysis of a cattle radius (No. 301) and multiple cuts on a cattle tibia (No. 342). Long bones of sheep (Nos 40, 124, 342, 356) bore similar scratchmarks, one of them (No. 124) clearly indicative of defleshing the forearm. The cuts on a sheep atlas (No. 301) may equally result from slaughtering and carcass partitioning (see below). Cuts related to bone manufacturing are discussed separately (Choyke, chapter 29).

A somewhat greater proportion, 0.3% of all mammalian bone, showed marks of burning. When divided into three major degrees of fire exposure, the remains of small mammals seem to have been more exposed at all levels.

In comparison with the entire material, burnt cattle bones are relatively overrepresented in comparison to those of sheep and goat. It is impossible to tell, however, whether this phenomenon is the result of roasting, garbage disposal or accidental burning. Consistent firing at several locations (Nos 301, 313, 307, 308, 321, 423, 445) was shown by the presence of several burnt bones in all three categories.

The zoological composition of the material

Zooarchaeology has traditionally been used in environmental reconstruction. Animal remains from archaeological sites, however, primarily reflect ancient decisions as to what animals were considered worth exploiting by the inhabitants of a site. Therefore, they can be used in characterising how early farming communities lived. This is especially true for domestic animals. While the remains of game, birds and fish represent the local fauna as selected by human action, domesticates are artefacts, products of culture in and of themselves. This is an especially important point to make when the first pastoralists are studied in our region.

Interpretation by animal species

In terms of NISP, over two thirds of the largest, Trench 23B sample are made up by the remains of sheep and, to some extent goat, dominating largely at the expense of cattle and especially pig among domesticates. In all periods, the contribution of wild animal remains (without deer antler, a material that can be gathered without killing the stag) remains below the minimum level of 10%, theoretically expected at sites where hunting played at least a complementary role in subsistence *(Fig. 14.4)*. As may be expected on the basis of *Fig. 14.5*, however, bone weights offer a rather different picture. Most remarkably, large bone fragments from mature aurochs make up a proportion equal to that of domestic cattle. This is the result of their mean weights being 2.5–5 times greater than those of the domestic variety *(Fig. 14.6)*. The contribution of both bovines (36% each) exceeds that of the caprine bones (24%) in terms of fragment weight. It is important to keep this in mind when the role of animal keeping vs. hunting will be discussed.

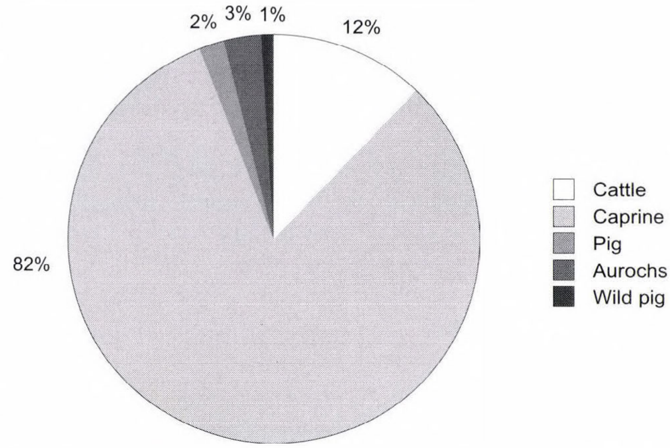


Fig. 14.4. The percentual distribution of 4559 animal remains by NISP

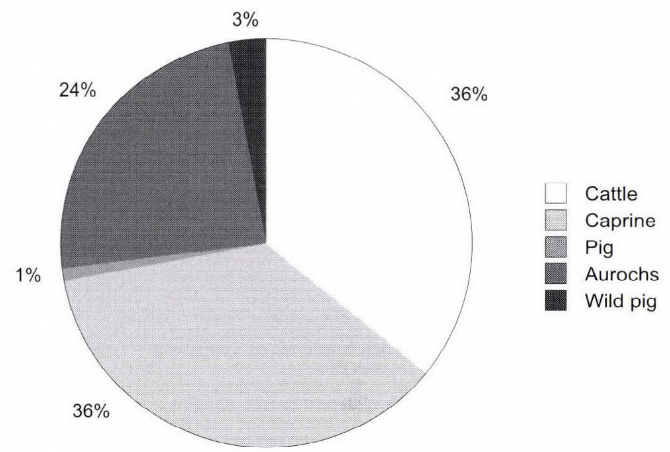


Fig. 14.5. The percentual distribution of 32,634 g animal remains by weight

Cattle (*Bos taurus* Linné 1758)

Cattle is considered one of the most important domesticates in many economies. Demand for the multitude of products (meat, hide, milk, draught power) by this slow-growing, unipara animal made cattle a basic element of stock keeping in many prehistoric communities. Cattle bones, however, are remarkably infrequent at many Körös culture settlements (including Ecsegfalva 23), as is shown by the steady 10–25% contribution of cattle remains to NISP. Most of these originate from mature animals that may have been slaughtered at the end of their productive lives.

By bone weight, beef seems to have played a relatively major role in the meat supplies of Ecsegfalva 23, while it remains a question to what extent live cattle were exploited for so-called secondary products. Traces of bovid milk protein detected on shards from Ecsegfalva could not yet be identified on the subfamily level, i.e. may equally originate from domestic cows or caprines.

In spite of the high contribution of mature cattle to the food refuse, none of these bones showed anomalies that could be interpreted as a functional hypertrophy caused by hard traction work such as ploughing (Bartosiewicz *et al.* 1993). In spite of the presence of cereal remains at the site, it seems that smaller plots of land could be easily cultivated without draught animals. And the relatively even distribution of arthritic deformations in the skeleton of prehistoric cattle changes only in later periods: chronic skeletal symptoms of overworking (especially in the hip joint and feet) become common only by the Roman and medieval periods (Bartosiewicz 2002a; 2006).

The withers height of only one individual of unknown sex could be estimated on the basis of the greatest length of its femur *(Appendix Table 14.VI)*. Dividing the known withers height with the greatest length of this bone in 16 modern Hungarian Grey cattle skeletons (5 cows, 5 bulls

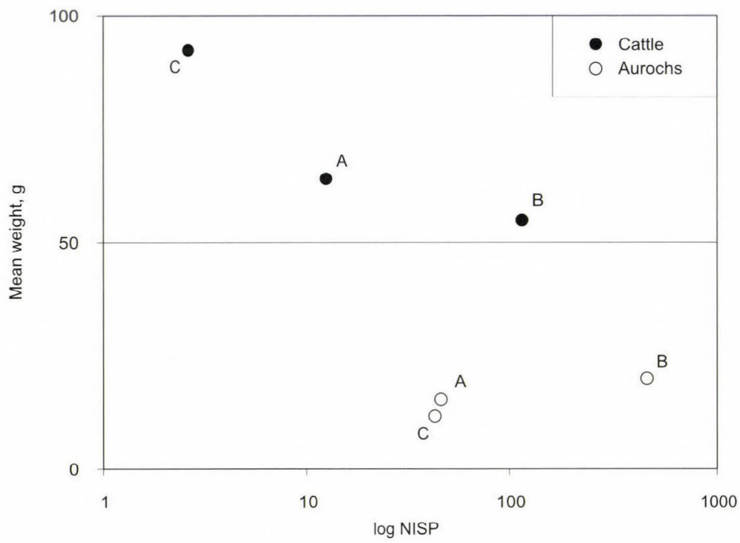


Fig. 14.6. Differences in the mean weights of bovine bone fragments in the three trenches of Ecsegfalva 23

and 5 oxen) a coefficient of 3.3 was obtained. This breed is considered unimproved by modern standards (Bartosiewicz 1997a) and was thus considered adequate for the calculation. The 1224 mm withers height thus obtained fits within the lower trend of Neolithic cattle in Hungary (Bökönyi 1974, 115), but somewhat falls short of the 1263 mm mean value calculated for 12 cows on the basis of metapodium lengths at the coeval settlement of Endrőd 119 (Bökönyi 1992a, 203).

The small and varied set of long bone measurements was compared to those of aurochs in *Fig. 14.7.* Standard scores (SC), following the logic of size indices (Uerpmann 1979) were used in standardising measurements taken on the long bones of both wild and domestic cattle for the purposes of pooled evaluation. Individual bovine measurements from Ecsegfalva 23 were entered into the following formula based on mean values (m_x) and standard deviations (sd_x) of the respective long bone dimensions of a sample of five bulls and six oxen of the Hungarian Grey breed:

$$SC = (x - m_x)/sd_x$$

The resulting standard score relates different domestic cattle and aurochs measurements from Ecsegfalva to those of Hungarian Grey cattle, plotting their variation around their mean value. It is important to emphasise that bone measurements of Hungarian Grey bulls/oxen were used merely to provide an interpretative framework within which it was possible to compare prehistoric domestic cattle and aurochs bones to each other. Fragmented bones could thus be pooled within the same graph, regardless of their anatomical positions.

According to the resulting pattern, the bones from bulls and oxen of this unimproved modern breed largely correspond to aurochs in overall size. The measurements of Ecsegfalva domestic cattle are, however, far smaller, some scoring a –4.4 standard deviation distance to the modern mean. This difference is overemphasised by the fact that many of the Ecsegfalva 23 cattle bones seem to be small enough to have originated from cows. In the large assemblage from Endrőd 119, Bökönyi (1992a, 203) estimated a 12 to 1 ratio between cows and bulls, which he explained as a possible sign of dairy exploitation.

The same histogram also shows a relatively small size overlap between wild and domestic cattle at Ecsegfalva 23. The interpretation of such an overlap has been debated during the Late Neolithic in the Hungarian Plain as a sign of local domestication. The pattern shown in *Fig. 14.7* seems to indicate no considerable overlap that could be interpreted this way. It thereby supports Bökönyi's (1992a, 205) opinion, that cattle had arrived in an already domesticated form in the Carpathian Basin as has recently been hypothesised in the Iron Gates gorge of the Danube, the entrance to our region (Bartosiewicz *et al.* 2006).

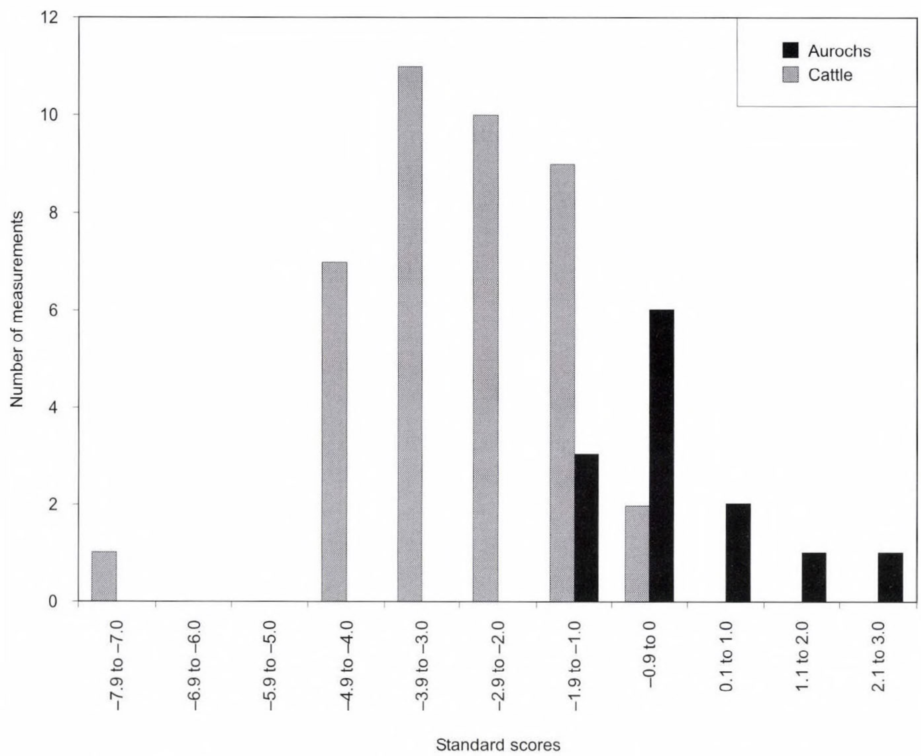


Fig. 14.7. The distribution of bovine bone measurements by standard scores

Sheep (*Ovis aries* Linné 1758) *and goat* (*Capra hircus* Linné 1758)
Given the relatively large size of this sample the overwhelming dominance of these two domestic animal species in terms of NISP is noteworthy. Unfortunately, this difference is swamped by the relatively great number of Caprine bones that could not be identified to species either as sheep or goat. Most sheep remains are indicative of relatively small individuals with meagre horn cores.

The contribution of goat bone was only 4.6% within the pooled assemblage of identifiable sheep and goat remains. This falls short of the usually characteristic 10% at many sites in Hungary. A 12% contribution by goat was described from Endrőd 119 (Bökönyi 1992a, 197). Three goat horn cores were of the straight, *aegagrus* type, an unimproved morphological feature widely associated with early domestication.

Withers height estimations, based on the greatest lengths of 12 fully preserved sheep long bones (Teichert 1975, 67) resulted in an average stature of 549 mm, which somewhat falls short of the 572 mm average withers height estimated from 159 long bones from Endrőd 119 (Bökönyi 1992a, 216). This difference, however, is not significant at the $P \leq 0.05$ level of probability; the Ecsegfalva 23 specimens would form only a sub-set within the ten times larger sample from Endrőd 119.

Owing to the relatively great number of measurable bones, sheep from Ecsegfalva could be further compared to those from Endrőd 119, pooling the standard scores of various bone measurements as was described in the case of cattle. The basis of reference in this case, was the group of 26 adult female Shetland sheep from a single flock studied by Davis (1996, 596, table 2), whose mean values and standard deviations provided the background for this analysis. As in the case of cattle, it is important to emphasise that comparison to this set of data is not meant to suggest any special relationship between Neolithic sheep and this modern, however, unimproved breed.

Figure 14.8 shows a clearly bimodal distribution of sheep bone measurements from both Neolithic sites. This may be interpreted as a manifestation of sexual dimorphism, since the mean

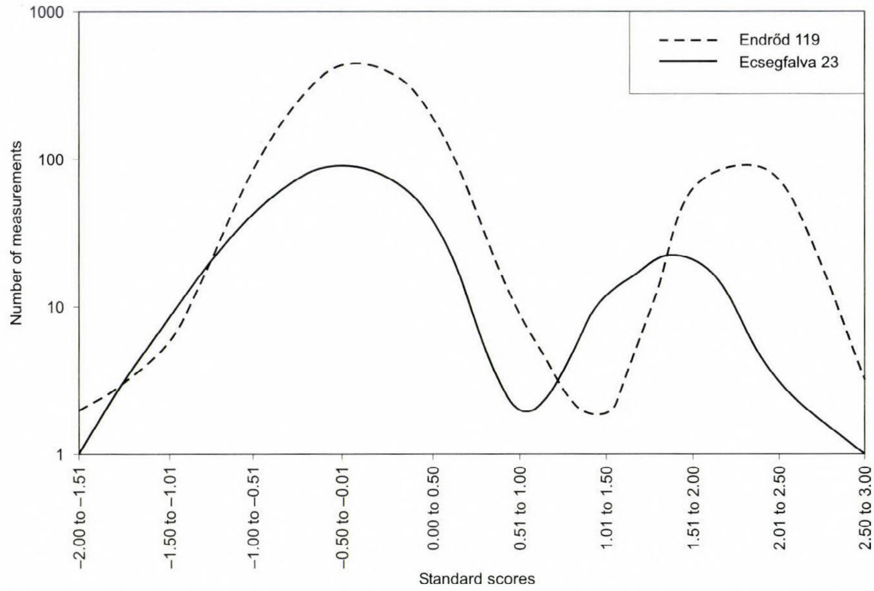


Fig. 14.8. The distribution of sheep bone measurements by standard scores

values of the groups of smaller animals correspond to the average skeletal measurements of female Shetland sheep. Using the coefficients by Teichert (1975), the mean withers height of these latter was estimated as 539.5 mm (Davis 1996, 596, table 2). This value is somewhat below the mean values of Körös culture sheep from both Ecsegfalva 23 and especially Endrőd 119, since these archaeological assemblages probably contain long bones from rams as well. This possibility is reconfirmed by the bimodal distribution of standard scores: in the absence of the wild ancestor, larger neolithic bones may be readily interpreted as originating from rams.

Indirectly, this hypothesis is further supported by the fact that such large bones seem to be fewer in number both at Ecsegfalva 23 and Endrőd 119. It is possible that many males were slaughtered already at a young age, while females were kept for both lambing and possibly milking.

Pig (*Sus* [*scrofa*] *domesticus* Brisson 1762) *and wild pig* (*Sus scrofa* Linné 1758)

Pig is often considered an 'index species' of pivotal importance, both from an environmental and a cultural point of view. Its presence among domestic stock is indicative of sufficiently humid and possibly forested habitats that could be exploited by pig keeping in the floodplain area.

Morphometric distinction between the remains of the domestic form and its wild ancestor native to this area is notoriously difficult. Confusion is further exacerbated by the possibility that these animals could have been *de facto* domesticated locally. Omnivorous wild pigs may have been attracted to human habitations at an early time, and during the Neolithic they may also have formed crosses with the domestic population that would again be difficult to recognise on a purely osteological basis (Bartosiewicz 1999a). This possibility is worth considering for two reasons. Evaluating the prehistoric fauna of Icoana, Bolomey (1973, 51) rejects the term 'domestic' for the pig population at the Iron Gates, but agrees that to some extent it 'suffered human control'. Therefore uncertainties in stratigraphic and zoological identification interfere with the hypothesis of the aforementioned possible 'control' of pigs by humans.

The occurrence of some very large Suid remains in the material offers clear evidence for hunting wild boar. On the basis of a large calcaneus, a withers height estimate of 916 mm was obtained (Teichert 1969, 273). This corresponds to the average of 43 modern wild boars (Faragó 2002, 366). The presence of this large game indicates that the natural habitat around the site was extremely favourable for pigs and was, in fact, humid and bushy enough to sustain populations of wild boar. This is consonant with the reconstruction of habitat by bird remains. Dabbling ducks (*Anas*) and diving ducks (*Aythya* and *Mergus*) are species associated with shallow or slow-flowing waters (Gál, chapter 19). Rather than being a forest game, wild pig prefers such marshland and reedbeds, where it can subsist on the plants' rhizomes. The present distribution of wild pig in Hungary has been limited to hilly woodland partly as a result of expanding agricultural cultivation in floodplain habitats (Faragó 2002, 368).

Dog (*Canis familiaris* Linné 1758)

Since dog meat does not seem to have formed part of the diet at Ecsegfalva 23, the bones of these animals occur relatively sporadically in the food refuse. On the other hand, they tend to be fully preserved and sometimes even may originate from the same individual.

Data in *Table 14.3* largely correspond to the size of small and gracile *palustris* type dogs, described from the Swiss and Slovenian Neolithic (Bartosiewicz 2002b, 83, fig. 12). Such animals were probably non-distinct, gracile, pariah dog-like individuals. They seem to have been a common form during the Neolithic, when no particular effort seems to have been spent on dog breeding. Unfortunately, no cranial remains were recovered at Ecsegfalva to permit a more detailed phenotypic reconstruction.

Table 14.3. Withers heights of dogs from Trench 23B estimated after Koudelka (1884)

	No.	GL, mm	Withers height, mm
Humerus	427	135.2	455.6
Tibia	427	154.0	449.7
Humerus	443	133.1	448.5
Femur	443	141.0	424.4

Only about 0.4% of the Ecsegfalva 23 finds, 22 bones showed unambiguous marks of dog gnawing. Half of these occurred on the remains of large herbivores that could not be ingested as easily as the bones of caprines, dominant in the assemblage (Bartosiewicz 2005/2006). Gnaw marks were discovered on a fox mandible as well, indicating that this bone was not a secondary deposit originating from a burrowing animal, but probably belonged to the settlement refuse. The scarcity of even the indirect evidence of gnawing shows that dogs must have been of limited importance at this site.

Aurochs (*Bos primigenius* Bojanus 1827)

Aurochs seems to have belonged to the natural habitat of the settlement, with its hypothesised preference for open grassland and gallery forests in floodplain areas. Their identification was simply based on the large size of bones, some of which were far too large to represent prehistoric domestic cattle. The hunting of these large game seems even more likely since, as was mentioned in connection with domestic cattle, owing to the apparently advanced state of domestication at this settlement, individuals of transitional size (potentially indicative of crossings between the wild and domestic forms) did not occur. Bones of large cattle, therefore, could be considered as indicative of hunting large game. Stratigraphic units that contained concentrations of more than 5 bones from this species included 301 (n = 7), 327 (n = 5), 423 (n = 8), 430 (n = 6) and 464 (n = 7).

Red deer (*Cervus elaphus* Linné 1758) *and roe deer* (*Capreolus capreolus* Linné 1758)

Both deer species identified at this site are indicative of open, parkland forests. Remains of roe deer, however, occur more commonly, since this smaller Cervid was better adopted to both grassland habitats and cultivated areas. In addition to antler remains (that, in principle, may be acquired by collecting or even trade), the bones of these animals prove that their small scale hunting was practised by the inhabitants of a settlement, otherwise agricultural in nature. Deer bone was found in no particular concentration at this site. Red deer antler, a potentially valuable raw material in tool making, was found only in the largest, 23B, assemblage. Three small fragments originated from red deer, while roe deer was represented by only two pieces. In the absence of the base, it is impossible to tell, whether these fragments originate from hunted animals or shed antler. It is also noteworthy, that no antler artefacts were identified in the Ecsegfalva assemblage (Alice Choyke, *pers. comm.*). Even in the large, pooled osseous tool assemblage of Endrőd 35, 39 and 119 as well as Szarvas 23, only three of the 631 artefacts were made from red deer antler (Makkay 1990a, 23).

Wild ass (*Asinus hydruntinus* Regalia 1907)
The European wild ass was strongly underrepresented even in the large assemblage from Endrőd 119 (16 of over 22,000 NISP). Although the two small, non-articulated and incomplete phalanges available for study here do not permit accurate size reconstruction, they are remarkably more gracile than those of horse. (A loose tooth from *Equus caballus* from the top layer of the settlement yielded a Modern Age radiocarbon date.) Hunting wild asses may have required considerable hunting skills and cooperative effort (Bökönyi 1992a, 225). This may be one reason why the bones of this grassland game animal are relatively rare at Körös sites, the only exception being Nosa-Gyöngypart in northern Serbia, where the relative contribution of this animal was remarkably high (Bökönyi 1984a, 30).

Wild carnivores
Articulated skeletal remains of red fox (*Vulpes vulpes* Linné 1758) may possibly originate from natural deaths in the case of these burrowing animals. In the absence of marks left by defleshing or skinning, therefore, it is difficult to interpret the way these animals had been exploited. On the other hand, when no complete skeletons but articulated limb bones are found, one may presume that the remains of an animal were discarded whose body was intentionally dismembered. The aforementioned gnawing marks of a fox mandible *(Fig. 14.9)*, and a burnt proximal phalanx may also be indicative of a deposit coeval with the settlement.

Fig. 14.9. Lateral view of a right fox mandibula with gnawing marks at the frontal edge

Using the coefficients developed for dogs by Koudelka (1884), a complete ulna yielded a withers height estimate of 405.8 mm. This falls into the upper size range of modern foxes measured in Germany and thus probably corresponds to a male (Faragó 2002, 287). In fact, both the size and robusticity of these bones far surpass those of an adult female from Denmark (comparative specimen kindly provided by Erika Gál).

Two bones from mustelids, stone marten (*Martes cf. foina* Linné 1758) and weasel (*Mustela erminea* Linné 1758) were also recovered. The only insectivore represented in the material, hedgehog (*Erinaceus europaeus* Linné 1758) may also be mentioned here. The exact forms of exploitation for these animals remain unclear.

Lagomorphs and rodents
The remains of hare (*Lepus europaeus* Pallas 1778), hamster (*Cricetus cricetus* Linné 1758) and souslik (*Citellus citellus* Linné 1766) are typical species of the Eurasian grassland that have sporadically been exploited for meat and fur (Bartosiewicz 1999b). The majority of these remains occurred in the largest, Trench 23B, sub-assemblage (i.e. their representation is largely a function of sample size). Their presence may be indicative of the expansion of grassland-type habitats, including cultivated fields, around the settlement.

Most remains of vole (*Microtus cf. arvalis* Pallas 1779) and other, non-identifiable small rodents came to light during water-sieving. Many of these animals may also be associated with more recently developed dry conditions in the area, and in the absence of individual dating it is impossible to tell when they burrowed into the archaeological layers. Rodent remains, therefore, have been summarised in a separate table *(Appendix Table 14.V)*.

Discussion

Ecsegfalva 23 and the roles of wild animals in the Körös culture

The role of hunting in the Körös culture is usually discussed in light of Mesolithic subsistence strategies, poorly understood in the Great Plain owing to the lack of numerous settlements. Known Mesolithic sites in the Carpathian Basin are best characterised by the presence of large game such as aurochs, red deer and possibly wild equids (Vörös 1987, 87), whose bones are often known from natural deposits (e.g. Bökönyi 1972a; Krolopp and Vörös 1982). People of the Early Neolithic Körös culture, however, introduced cultivation on natural levees and embankments alongside riverbeds (Kertész 1996, 25) and kept domestic animals, especially cattle and sheep. The remains of wild mammals and fish at several Neolithic sites indicate a continuing reliance on these resources, although a diachronic decline becomes apparent over the long run.

It is a widely held opinion that, in contrast to the Thessalian Plain of northern Greece, where the remains of domestic animals make up 90–95% of faunal assemblages, there are generally fewer domesticates in the Early Neolithic Körös sites in Hungary (c. 75%: see Bökönyi 1989). Aside from serving as open waterways, marshy floodplains in this area offered a suitable habitat for a number of game animals as well as domesticates.

A survey of faunal lists from the region (including sites beyond the political borders of modern day Hungary), shows that wild animals were consumed at all major sites, especially near the Iron Gates Gorge. Given the narrow spectrum of domesticates exploited during the Early Neolithic (the basic 'package' included only five species: sheep, goat, cattle, pig and dog), taxonomic richness, i.e. the number of species identified in a given assemblage, is a good first approach to appraise the role of hunting in Körös culture economies.

Large archaeozoological assemblages from the Körös culture from the Great Plain are characterised by domestic animal percentages of approximately 90%, emulating the situation typical of the Thessalian Plain. In small samples, however, the presence of even a few wild animal remains may result in great wild animal proportions, thereby inflating the 'significance of hunting in the economy'. Thus, the variability in 'hunting as an alternative subsistence strategy' is to some extent an artefact of assemblage size that varied widely between the sites under discussion here. The coefficient of Spearman rank correlation between the number of identifiable mammalian bones and the percentage of domestic animal remains from 17 Early Neolithic sites *(Fig. 14.10)* was high ($R = 0.620$) and statistically significant ($P = 0.032$). This shows that statistically representative assemblages tend to be unambiguously dominated by the remains of domesticates (Bartosiewicz 2005).

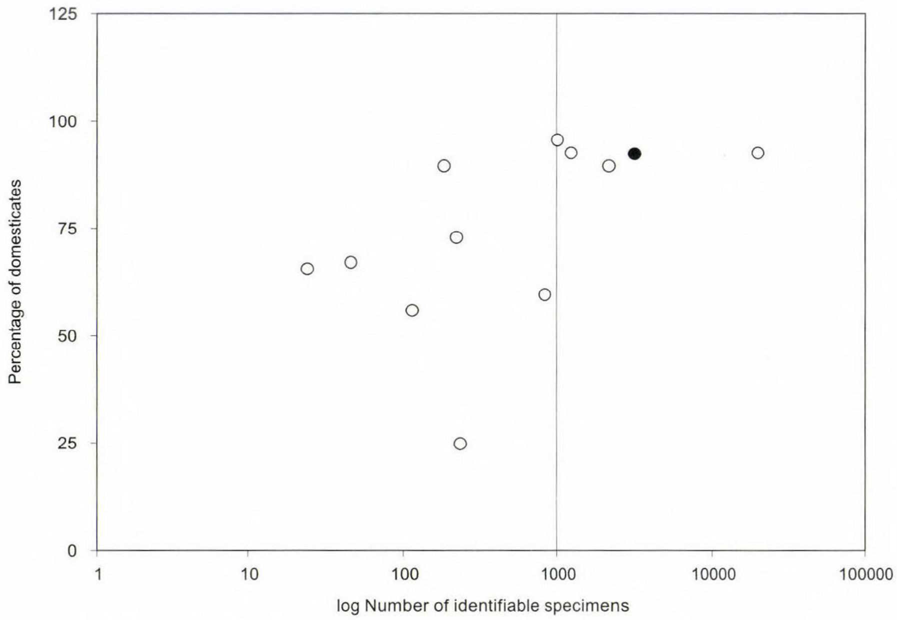


Fig. 14.10. The relationship between assemblage size and the percentual contribution of domesticates to NISP. The full circle stands for Ecsegfalva

Some of the relatively few wild animals were possibly killed as a form of prehistoric 'luxury' hunting. This is consistent with the hypothesis that large game were of great cognitive importance in the community's imagery, but they were relatively rarely exploited for meat. At the other extreme, the evidence of crop cultivation directs attention to the possibility of protective hunting on the plots in the settlement's proximity. In this case pragmatic, rather than ideological reasons may lay behind occasionally killing game. Naturally, the possibility that hunting was primarily an economic activity, aimed at complementing meat supplies, should not be ruled out either. Procuring even only 10–20% of the meat by hunting, however, requires a disproportionately great investment of time and labour in comparison with animal husbandry (Whittle 2003, 90).

Among the Körös culture sites published in the literature, the contribution of fur-bearing animals appears especially impressive in the tiny assemblage Kőtelek-Huszársarok. Over half of the animal remains, 13 out of 22, originate from wild cat and red fox (Vörös 1980, 59). When assemblage size is seriously considered, however, Körös culture animal exploitation in the Great Plain looks somewhat more homogeneous than previously thought. This is in contrast with the faunal assemblages identified downstream along the Danube, towards and within the Iron Gates Gorge, where even large assemblages contain major percentages (35–65%) of wild ungulate remains.

The overall perception of at least one game animal is also worth considering here. At Endrőd 119, a complete shed red deer antler was found with a lamp and a vessel at either end, deposited under several layers of charcoal, in an apparently sacrificial context (Makkay 1990a, 23). This find is not necessarily related to a hunting tradition (shed antler is acquired by gathering), but shows the importance of an animal that lived in that settlement's environment. Similarly to Ecsegfalva 23, red deer remains made up only 0.6% of NISP in the Endrőd 119 assemblage (Bökönyi 1992a, 197: contribution of antler not specified). Stags are also depicted on vessels. One of the best known representations, found at the Körös culture settlement of Csépa (Kutzián 1944) shows an animal with what looks like three antlers, possibly emphasising this trait or even showing limited familiarity with the animal itself (Clive Bonsall, *pers. comm.*). The sporadic remains and representations of red deer may be indicative of a wild animal left alone as a mark of continuing respect for the wild (Whittle 2003, 93), in a community largely dependent on the exploitation of domesticates.

The age of animals: seasonality

Establishing the age of animals identified in the archaeozoological assemblage has two aims. Firstly, since these remains usually represent consumption refuse, they are indicative of decisions as regards to slaughtering younger or older animals that may have had a bearing on herd structure. In addition, familiarity with the reproduction seasons of various animals contributes information on the time of settlement occupation. Naturally, the absence of skeletal elements from younger animals does not prove that the area would have been abandoned at that time. Selective deposition and differential destruction tend to reduce evidence for newborn and juvenile animals in different sections of a settlement.

The age at death may be estimated either from tooth remains and the state of epiphyseal fusion in various bones. Of these two possibilities, the identification of dental ages (tooth eruption and -wear) is more precise and can be more easily converted into the minimum numbers of individuals. Other skeletal elements occur in greater numbers but offer only *terminus post quem* ages, that is the time when the epiphyseal plates of a certain bone ossify, thereby terminating longitudinal growth. These ages vary from epiphysis to epiphysis within the skeleton and even between the proximal and distal ends of the same long bone (Hammond 1932). In extremely old animals, the overall robusticity of bone or age-related, sub-pathological exostoses may be used in the morphological identification of age.

In the animal bone assemblage under discussion here, tooth eruption data after Habermehl (1961; 1985) were used in establishing gross dental ages, while epiphyseal fusion data were evaluated using the absolute age criteria as summarised by Schmid (1972, 75). Given the presumably earlier maturity of modern domesticates, however, relative age categories (*neonatus, juvenilis, subadultus, adultus, maturus, senilis*) rather than absolute numbers of years were used in this study.

Sheep and goat

The best represented and culturally most idiosyncratic group of animals was that of sheep and goat, with an overwhelming dominance of sheep remains among the bones identifiable to species. The ageable remains of these animals are, therefore, first discussed together. The largely non-distinguishable teeth of sheep and/or goat were distributed among tooth types and age classes as shown in *Table 14.4.*

Owing to the relatively large size of the caprine tooth assemblage, in the case of this taxon it was possible to compare age profiles obtained by both these data and epiphyseal fusion. Whilst teeth can be more precisely aged and also lend themselves a little bit more realistically to the estimation of the minimum numbers of individuals, ageable bone fragments tend to be much more numerous. It was hypothesised therefore that the distribution of teeth and other skeletal elements would be largely homogeneous between respective age classes. Epiphyseal ages, as observed on various bones of the skeleton, are summarised in *Table 14.5.*

Although the proportions of different age classes to each other look similar in *Fig. 14.11*, owing to the difference in sample sizes (teeth make up only 19% of all ageable sheep/goat remains) this tendency is difficult to appraise by the naked eye. The sums shown in *Tables 14.4* and *14.5* were compared using a Chi^2 test, in order to decide whether the null hypothesis that the two methods result in identical age profiles could be accepted. The expected values thus calculated are shown in *Table 14.6.*

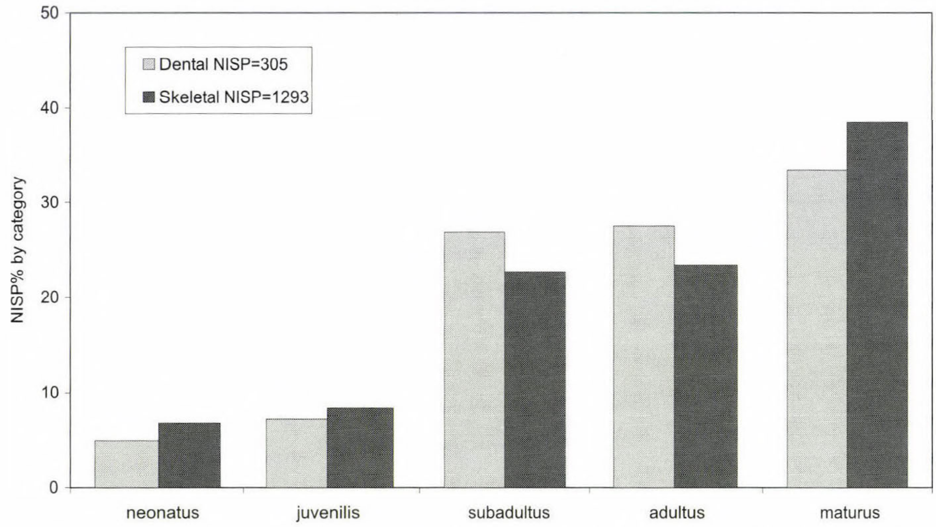


Fig. 14.11. The percentual contribution of ageable caprine remains

Younger age classes seem to be underrepresented in the sample of teeth. The $Chi^2 = 6.861$ value (degrees of freedom = 9), however, is indicative of only small, statistically non-significant ($P \leq 0.651$) deviations from the expected values. The null-hypothesis is therefore valid: ageing results obtained using the two different methods are homogeneous, i.e. do not differ significantly. Interestingly enough, dental ageing data and MNI are very closely correlated with each other ($r = 0.996$; $y = 5.909x + 13.956$) at the site of Ecsegfalva 23. From a methodological point of view this result also shows that, thanks to screening and water-sieving, the small deciduous teeth of neonatal and juvenile sheep are not significantly underrepresented in the assemblage. These would almost certainly have been lost, if only hand-collection was practised (Bartosiewicz 1988).

Table 14.4. The distribution of caprine teeth by age classes

Dental NISP	neonatus	juvenilis	subadultus	adultus	maturus	Total
			Lower toothrow			
i_1/I_1	1	2	1			4
i_2/I_2	9	5	7	7	5	33
i_3/I_3	1	2	1	3		7
c/C		1	2			3
m_1/P_2	2	4	13	9	4	32
m_2/P_3	1	4	14	6	2	27
m_3/P_4		3	18	10	2	33
M_1			8	11	11	30
M_2			2	7	5	14
M_3			1	1	4	6
			Upper toothrow			
m^1/P^2	1		2	3	5	11
m^2/P^3		1	2	4	10	17
m^3/P^4			2	5	7	14
M^1			5	10	23	38
M^2			3	7	16	26
M^3			1	1	8	10
Total	**15**	**22**	**82**	**84**	**102**	**305**
MNI	(15)	(16)	(45)	(47)	(84)	(207)

Table 14.5. Age distributions based on epiphyseal fusion in sheep and goat

Skeletal part NISP	Embryo	neonatus	juvenilis	subadultus	adultus	maturus	Total
Dental NISP		15	22	82	84	102	305
Neurocranium		1	4	10	18	14	47
Viscerocranium		4	2	6	3	17	32
Maxilla			2	4	2	3	11
Mandibula	1	2	4	6	5	7	25
Atlas		1		1	1	9	12
Axis					1	5	6
Vertebra cervicalis		1	1	3	5	32	42
Vertebra thoracalis		7	7	7	14	15	50
Vertebra lumbalis		2		6	25	16	49
Os sacrum		1	1	1	3	3	9
Scapula		4	8	9	11	18	50
Humerus	1	12	7	25	12	36	93
Radius/ulna		8	7	14	19	23	71
Carpalia		1				10	11
Metacarpalia	2	4	11	20	17	24	78
Phalanx proximalis			3	19	27	43	92
Phalanx media		1	1	5	8	27	41
Phalanx distalis		1	1	2		3	7
Pelvis	1	4	6	4	10	11	36
Femur	2	4	4	18	12	15	55
Tibia	2	8	7	26	15	15	73
Calcaneus			5	8	1	9	23
Astragalus		1	1	3	8	11	24
Centrotarsale		1				6	7
Metatarsalia	1	5	4	14	5	24	53
Total	**10**	**88**	**108**	**293**	**306**	**498**	**1303**

One may only speculate whether the higher ages observed in cattle are related to some form of secondary exploitation *sensu* Sherratt (1983c).

Owing to their absence in the dental record, the remains of foetal sheep could not be included in this calculation. The diaphyseal lengths of a femur, tibia and metatarsus from the same lamb are indicative of a foetal age of approximately 50–60 days (Prummel 1989, 77). This means that the ewe was approximately at half of her gestation period, i. e. she died during the late winter/early spring. Neonatal and juvenile lambs (15% of NISP) would also have been probably slaughtered during the first half of the year.

This conclusion, especially the high incidence of winter/spring lamb deaths, is corroborated by the evidence of dental annuli, used in a more precise assessment of age in a smaller sample of individuals (Pike-Tay, chapter 16).

Both sets of evidence point to a possible winter/spring base, with potentially more dispersal in the summer months over a wider landscape. In the absence of related finds form this 'wider landscape', however, it is impossible to tell whether this hypothesised movement between pastures may be considered some simple form of transhumance (see below).

Table 14.6. A comparison of age group distributions by dental and epiphyseal ages in caprines

Basis of ageing		neonatus	juvenilis	subadultus	adultus	maturus	Total
Dental NISP,	observed values	15	22	82	84	102	305
	expected values	*19.7*	*24.8*	*71.6*	*74.4*	*114.5*	
Skeletal NISP,	observed values	88	108	293	306	498	1293
	expected values	*83.3*	*105.2*	*303.4*	*315.6*	*485.5*	
Total		**103**	**130**	**375**	**390**	**600**	1598

Cattle

Although domestic cattle seems to be the second best represented species at this site, its teeth occurred in remarkably small numbers. In contrast to sheep/goat, the teeth of very young individuals are completely missing. At least two substantially worn incisors, however, seem to originate from very old, senile individuals, an age class completely missing in the five times larger sample of ageable caprine remains *(Table 14.7)*.

Since the number of ageable cattle remains is relatively few, and (as opposed to the caprine sample) teeth make up less than 7% of this sub-assemblage, it is especially important that the age distribution of all possible skeletal parts be taken into consideration. Among the skeletal elements the remains of at least a few young (neonate and juvenile) calves occur, they make up, however, only ca. 4% of the ageable cattle bone assemblage *(Table 14.8)*.

In order to facilitate the interpretation of differences observed between the assemblages of caprine and cattle bone respectively, mortality curves of these two taxa were outlined in *Fig. 14.12*, on the basis of (comparable) skeletal NISP values. Sheep (and goat) in this graph display a typically monotonous decrease of ages with the advancement of time. The curve obtained for cattle is much more 'shouldered' due to the better representation of ageable bones from, especially, mature individuals. Since the sample of caprines and cattle differed in size, a Chi-Square test was carried out to confirm the validity of this observation *(Table 14.9)*. Owing to the small number of cases, the categories of foetal, neonatus and senilis remains had to be left out of this calculation.

The $Chi^2 = 104.862$ value (degrees of freedom = 3) calculated from this table is indicative of statistically significant ($P \leq 0.001$) deviations from the expected values, i.e. the sample shows heterogeneous age distributions. The null-hypothesis, therefore, should be rejected: ageing results for caprines and cattle are statistically different. Young cattle, especially,

Table 14.7. The distribution of cattle teeth by age classes

Dentes NISP	subadultus	maturus	senilis	Total
Lower toothrow				
i_1/I_1		1	2	3
i_2/I_2				
i_3/I_3				
c/C				
m_1/P_2				
m_2/P_3				
m_3/P_4				
M_1		2		2
M_2	1	1		2
M_3				
Upper toothrow				
m^1/P^2		1		1
m^2/P^3		1		1
m^3/P^4		1		1
M^1	1	1		2
M^2	1	6		7
M^3	1	1		2
Total	**4**	**15**	**2**	**21**
MNI	(2)	(9)	(2)	(13)

Table 14.8. Age distributions based on epiphyseal fusion in cattle

Skeletal part NISP	neonatus	juvenilis	subadultus	adultus	maturus	senilis	Total
Dentes NISP			1		2	2	5
Neurocranium					11		11
Viscerocranium					9		9
Maxilla				2	2		4
Mandibula		1			15		16
Atlas			1		2		3
Axis					4		4
Vertebra cervicalis		1	1		10		12
Vertebra thoracalis				1	19		20
Vertebra lumbalis				3	12		15
Os sacrum				2	2		4
Scapula			1	1	6		8
Humerus	1	4	3	2	12	1	23
Radius/ulna			3	1	10		14
Carpalia				3	9		12
Metacarpalia		1	2		6		9
Phalanx proximalis			2	2	6		10
Phalanx media		2	5	1	2		10
Phalanx distalis					1		1
Pelvis			2	2	12		16
Femur			3	1	19		23
Tibia			1	7	27		35
Calcaneus			2	2	1		5
Astragalus					4		4
Centrotarsale					3		3
Metatarsalia	1	1	4	3	10		19
Total	**2**	**10**	**31**	**33**	**216**	**3**	**295**

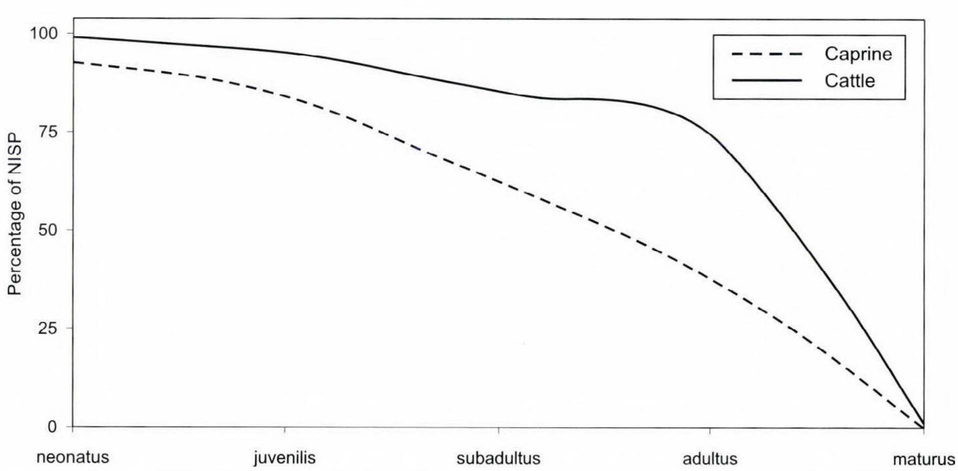


Fig. 14.12. Mortality curves of domestic bovids at Ecsegfalva 23

seem to be underrepresented. From a taphonomic point of view this is all the more interesting, since one would expect the loss of small lamb bones with greater probability than those of relatively large calves. Therefore, the difference between the two mortality curves seems to show the different roles caprines and bovines played in the diet. It is evident that cattle were slaughtered at an older age than sheep or goat. The only question is how one can interpret this substantial dif-

Table 14.9. A comparison of age group distributions in caprines and cattle

Taxon		juvenilis	subadultus	adultus	maturus	Total
Caprine NISP,	observed values	**130**	**375**	**390**	**600**	**1495**
	expected values	*116*	*336.5*	*353.9*	*688.7*	
Cattle NISP,	observed values	**10**	**31**	**37**	**231**	**309**
	expected values	*24*	*69.5*	*73.1*	*142.3*	
Total		**140**	**406**	**427**	**831**	**1804**

ference. First of all, reproduction rates are a lot higher for small stock, since the loss caused by killing one individual (regardless of its age) can be recovered in a relatively short time. Fattening larger animals takes a major investment both in time and fodder, therefore the slaughtering of a cattle tends to be subject to more careful consideration. In addition, in the absence of evident means of Neolithic meat preservation in Hungary, the approximately five times more meat in a single cattle probably needed cooperative consumption as well. Hence sheep and goat tend to be looked upon as 'small change' in animal husbandry (Dahl and Hjort 1976).

It remains a question whether the difference between the mortality curves of caprines and cattle may also be interpreted in terms of secondary exploitation, especially since the sex of the animals could only seldom be identified. Therefore, Sebastian Payne's classical models of modern sheep and goat exploitation (Payne 1973) could not be directly applied.

Aurochs

Given the relatively great contribution of aurochs bones to the assemblage under discussion here, it was this species of all wild animals that was worth studying in detail. Although distinguishing bones from wild versus domestic cattle is often impossible in the case of fragments, ageable skeletal elements tell something about the size of animals within age cohorts, thereby offering yet another detail that can be used in fine-tuning species identification. In spite of this, accurately identifying calves in either form of bovine is less reliable than recognising old, but gracile Early Neolithic cattle and huge aurochs.

The eight aurochs-size teeth originated from an adult and three mature individuals. The distribution of more numerous ageable skeletal parts (109 pieces of 133 NISP) is dominated by the remains of mature individuals, and the bones of senile aurochs are relatively more common than was the case with domestic cattle. The distribution of individual bones by age categories is shown in *Table 14.10.*

The overwhelming dominance of bones from very old animals contributes valuable information on how at least some of these animals may have been acquired. A typical attritional age profile is characterised by an overrepresentation of young and old individuals in comparison with their numbers in live populations. In a cultural context this may be interpreted as a sign of hunting the most vulnerable individuals. In his classic study of the Klasies River Mouth Cave site in South Africa, Klein (1982, 154) observed this age profile in the case of Cape buffalo, an evidently formidable prey item for Mesolithic hunters there. An alternative explanation for attritional age profiles is scavenging or at least hunting feeble, solitary and senile animals, which actually might explain the overrepresentation of bones from only old animals among the remains of aurochs (at the other end of the age scale, calves would have been protected by the entire herd). This hypothesis, although not testable at this point, seems to coincide with the small numerical representation of wild animals at major Körös culture sites in the area, as well as the near absence of stone, bone

Table 14.10. The anatomical distribution of ageable aurochs bones

Skeletal part NISP	neonatus	subadultus	adultus	maturus	senilis	Total
Dentes NISP				3		3
Neurocranium				8	1	9
Maxilla				1		1
Mandibula		2	2			4
Atlas				1		1
Vertebra cervicalis				4		4
Vertebra thoracalis			1	7		8
Vertebra lumbalis				4		4
Scapula				4		4
Costa				6	3	9
Humerus				2	1	3
Radius/ulna				8	2	10
Carpalia				5		5
Metacarpalia				5		5
Phalanx proximalis				10		10
Phalanx media				5		5
Phalanx distalis				4		4
Pelvis				1		1
Femur				3	1	4
Tibia	1		1	6		8
Calcaneus			1			1
Metatarsalia			2	4		6
Total	**1**	**2**	**7**	**91**	**8**	**109**

or antler projectile points in the inventory of archaeological artefacts. It is thus possible that one is dealing with a farming community that had limited interest and/or expertise in exploiting potentially dangerous wild animal resources, in spite of the high meat yields offered by large game. Dangerous wild animals must have had a special position in the cognitive landscape of Körös culture pastoralists in the Great Hungarian Plain that would be difficult to reconstruct in finer detail. This relative lack of hunting seems to be in sharp contrast to the older Early Neolithic of the Iron Gates region where the abundance of wild animal remains reflects first hand evidence on attitudes towards the 'wild' (Bökönyi 1970; Bartosiewicz *et al.* 2001, 18).

Assessing human mobility in the Ecsegfalva region

A functional parallel to the diffusion of sheep and goat into the Carpathian Basin may be seen in modern transhumance herding. The concept, however, should be treated with extreme caution.

The essence of transhumance is the seasonal migration of livestock to suitable grazing grounds. Although Sherratt (1972) suggested the possibility of transhumance in south-east Europe during the Neolithic, the term seems anachronistic for pre-Roman migratory sheep farming (Slicher Van Bath 1960). 'Proper' sheep transhumance (the seasonal, vertical movement of flocks between summer and winter pasturages) may have only become necessary when specialised sheep farmers started producing for a market (Clason 1998, 179) that made the intensive exploitation of the already busy agricultural landscapes of Europe a pressing necessity. Historically, this is best documented during the emergence of the wool industry.

Given the environmental conditions in the Great Plain, Barker (1975) correctly hypothesised a seasonal movement of Starčevo people living in the plains of the Voivodina that followed rises in floodwater levels in the alluvial environment. Chapman (1981) went even further, suggesting that there may be evidence for short-range transhumance linked with prospecting up to 50 km, and long distance transhumance over 50 km. The difficulty of testing these hypotheses is that while prospecting, long-distance trade, exchange or contact can be documented by archaeological artefacts, the same artefacts cannot be taken as evidence for transhumant herding (Clason 1998, 182).

What makes the ethnographic parallels of transhumant farming relevant here are the parameters of mobility that characterised the movement of sheep flocks, regardless of the timing or spatial dimensions of herding. If, as a zoogeographical fact, sheep and goat reached the Carpathian Basin by human-driven diffusion, their spread must have been characterised by a certain speed. Whatever the motives for population movements may have been, the herding of animals must have placed limitations on its speed. For one thing, speed depended on seasonality (which may have been taken advantage of in transhumance-like cyclical movements), and the qualities of terrain, both in topographic and geopolitical terms.

Regardless of the actual displacement of human populations, sheep and goat had to reach the Carpathian Basin by diffusion. In 1996 and 1997, Spanish transhumant herders interviewed by Moreno García (1999, 165) covered, on average, 19 km daily. Even if the speed of Neolithic herding was only half this high it must have been still quite respectable. Importing caprines by exchange and trade may have taken longer, but still could take place within a very short time compared to the chronological boundaries of the Körös culture (Whittle *et al.* 2002).

As for the potential volume of transhumant sheep drives, a local historical analogy is worth considering. Between 1838 and 1840, on average, 1.2 million sheep and goat were driven annually from mountain pastures in the Carpathians to winter pastures on the Great Hungarian Plain, Wallachia and Moldavia. Herds were kept on the Hungarian Plain between October and late April. As for species composition, not counting the presence of horses in the modern example, approximately 10% of these transhumant herds were composed of cattle, while the rest were caprines, predominantly sheep (Bartosiewicz 1999c, 49, fig. 2). Although absolutely no argument is being made here for interpreting transhumance from animal bones alone, this species proportion is still remarkably similar to what is found at major settlements of the Körös culture.

It must be repeatedly emphasised that superficial similarities between Körös culture animal exploitation and modern transhumance should not be taken at face value. The aforementioned parameters, however, help in technically defining the ranges in time/space and volume within which the first appearance of Neolithic domesticates may have taken place with or without the arrival of actual farming communities.

Deformations in mammalian bone

Given the considerable numbers of bones recovered from this site, only a relatively small number of fragments showed notable deformations. These may be reviewed even within the simple descriptive system proposed by von den Driesch (1975, 167). In this empirical classification three main categories of pathological modifications were distinguished:

1. Dental anomalies
2. Lesions caused by overworking and mistreatment
3. Traumatic lesions

No inherited dental anomalies could be observed in this material. The other two groups were represented mostly in the large sheep bone assemblage. While the signs of outright mistreatment are rare even within the small set of pathological modifications, some symptoms observed on the bones may be regarded as indications of environmental stress.

A special form of tooth deformation, related in part to the quality of grazing grounds, was observed on a loose left cattle incisor found in Trench 23C *(Figs 14.13–14)*. Lateral indentations below the crown of this tooth have been observed in a number of animal species. In the nineteenth century, this pattern found on the incisors of cave bear were interpreted as marks of manufacturing beads or pendants (Struckmann 1884). These were first identified by Hahne (1908, 56, Taf. 19/2–4) as irregular toothwear. The same phenomenon was observed on the incisors of red deer (Pucher 1986, 115, Abb. 53). Identical, wedge-shaped indentations were found on the milk incisor of a thirteent century cattle from Freyenstein, Germany (Müller 1990, 150–1, Abb. 5–6), and a Neolithic example in cattle was mentioned by Cavallo (1997, 77) from Tell Sabi Abyad in Syria. The appearance of this deformity is near identical in all species. It seems that the softer dentin below the tooth's crown was eroded by silica rich grasses, as these animals tear down the plants, thereby 'flossing' both sides of their incisor teeth (Tasnádi-Kubacska 1960, 114). In addition to the graze itself, soil particles ingested with the grass may further erode the tooth's neck (Bartosiewicz 1989).

The right mandibular fragment of a mature sheep from Trench B, showed a grave case of parodontitis: the alveolar area was swollen and the premolar teeth were lost *in vivo*. The first comprehensive archaeozoological study of such marginal parodontopathies was published out by Haimovici and Haimovici (1971). They analysed some 4200 fragmented toothrows (70% mandibula) from numerous sites in Romania, from between the third millennium cal BC to the first century AD. In this vast material they found only 2 affected tooth rows of red deer, 6 cases of sheep and only single incidences of cattle, pig and horse respectively (Haimovici and Haimovici 1971, 261–6, figs 1–11). The authors concluded that periodontal disease in domesticates increased with 'civilisation'. The multicausal aetiology of this condition in herbivores certainly includes overgrazing; the removal of edible grasses from pastures of limited extent creates a vacuum often filled in by thorny weeds that are avoided by livestock under ordinary circumstances. Poor quality weeds are increasingly mixed with the remainder of edible grasses increasing the incidence

Fig. 14.13. Occlusal view of a left second cattle incisor showing sub-pathological indentation

Fig. 14.14. Buccal view of the same cattle incisor showing sub-pathological indentation

Fig. 14.15. Plantar view of the distal end of a sheep metatarsus with arthrotic exostoses

Fig. 14.16. Ventral view of a sheep atlas with fine cutmarks near the anterior end

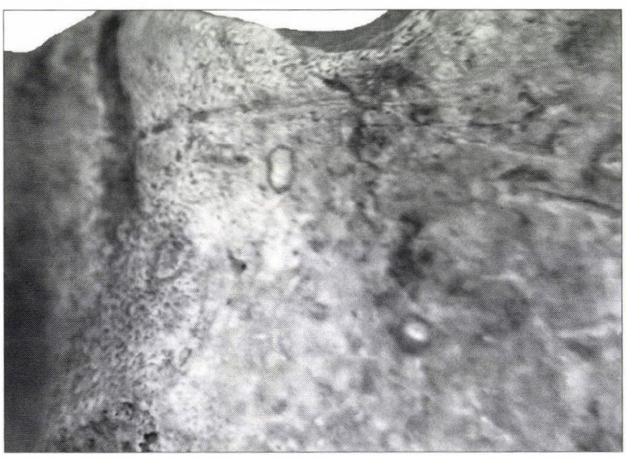


Fig. 14.17. Close-up of the cutmarks on the same sheep atlas

of oral injury. A single case, unfortunately does not prove this situation at Ecsegfalva, but may indicate environmental stress on the sheep population. Bökönyi (1992a, 232, fig. 26.1) described similar cases from the neighbouring site of Endrőd 119. However, even he found the number of such cases rather low at that site.

Aside from the quality of graze, possibly contributing to the aetiology of the aforementioned disorders, the arthrotic (i.e. chronic) joint deformations of limb bones are also often interpreted as signs of environmental stress, especially in domesticates which were unlikely to have been exploited for draught. Exostoses were observed on the distal end of a proximal phalanx from a sheep as well as on the distal end of a sheep metatarsus *(Fig. 14.15)*, both from Trench 23B. The two bones originated from different animals, but show the same joint being affected. Bökönyi (1992a, 230–1) described not only arthritic sheep phalanges from Endrőd 119, but similar lesions in the shoulder joints of goats.

It would be convenient to attribute these deformations to the environmental stress, to which newly arrived caprines were exposed in a marshy environment. However, the distal end of a 3rd wild boar metacarpus from the same trench (23B) showed similar exostoses. Although this animal species is perfectly adapted to the humid habitat in which the site was located, in this case it is the old age of the animal which may explain the formation of an arthrotic joint.

Fine flint cutmarks were observed on the cranial end of the ventral side of a sheep atlas *(Figs 14.16–17)*. Such cutmarks are widely hypothesised to be *perimortem*. This type of injury was observed, among others, on the articulated atlas and axis of a c. 800 BC pig from Tell es-Salihiyeh, Syria (Lepiksaar 1990, 117), and on the atlas of both a sheep and a goat at Late Bronze Age Kamid el-Loz, Lebanon (Bökönyi 1985a, Taf. 85/1–2). Analogous transversal cutmarks were discovered on a small camelid (*Lama* cf. *pacos*) atlas from the fifteenth century, Inka Period site Incarracay, Bolívia (Bartosiewicz 1999d, 104). Gilbert (1988, 85, fig. 5, Pl. XIV/1–4), however, distinguished two kinds of such marks on sheep atlases from Godin Tepe, Iran (c. 2600–1500 BC):

1. made during the animal's slaughter (cuts running from side to side across the ventral surface after having penetrated the throat's soft tissue)
2. caused by subsequent decapitation (with cuts on the anterior edge of the *fovea articularis cranialis*)

Of these two possibilities, only slaughtering marks are relevant to the discussion of *perimortem* trauma. Shorter cuts, although located on the ventral surface, lay close to the atlantooccipital joint. Therefore they may be alternatively explained by regular carcass partitioning or slaughtering. A similar cutmark was noted on a cattle atlas from the early Late Neolithic Horgen Period settlement of Schützenmatt, Switzerland (Chaix 1989, 45, fig. 3). Flint blades would have been too short for cutting straight across a cow's throat during slaughtering. Chances would have been better in the case of a small ruminant, but there must have been still simpler ways of killing the animal.

The only other deformation caused by trauma in the material was a healed fracture on the rib of a large bovine, evidently aurochs from Trench 23B. In a large sample of pooled pathological bones from prehistoric sites in the Near East, wild animals were represented only by aurochs and brown bear (*Ursus arctos* Linné 1758). This clearly illustrates that chronic deformations are more likely to develop in large game with only a few natural predators (Bartosiewicz 2002c, table 4). The presence of these bones among archaeological finds shows in and of itself that aurochs and, in the case of Ecsegfalva, had practically no predator other than humans.

Conclusions

Environment, settlement and exploitation of resources have always been vital and interrelated dimensions of culture. The Neolithic of the Great Hungarian Plain in the Carpathian Basin is characterised by a trend towards increasing regional differentiation in settlement and patterns of subsistence. In south-eastern Hungary, this trend apparently began with the arrival of farming and/or the first farmers associated with the Early Neolithic Körös culture (c. 6000–5500 cal BC).

The general environmental setting

The greater concentration of Early Neolithic human populations compared with what was presumably the situation in the Mesolithic was probably accompanied by increasing deforestation. The resulting clearances gave place not only to agricultural land but also pasture, predominantly exploited by sheep and goat. Caprine-based animal husbandry became dominant and successful in the Balkans where the climate and topography were comparable to what could be found in the Near East where sheep and goat had been domesticated. Consequently, sheep and goat, the leading species of the earliest domestic fauna, thrived there. In comparison, the Carpathian Basin was cooler and significantly more humid, sometimes even marshy, thus, not at all ideal for raising caprines in many parts of the varied, mosaic-like environment. In the marshland habitats along rivers and oxbows it must have been difficult to successfully keep newly imported sheep and goat, which prefer drier conditions. Favourable graze may have been limited to loessic levees, where animal grazing competed with early agriculture.

Deforestation is often seen as a conscious human activity caused by intensive forest clearance for horticultural activities. Without questioning the importance of crop production, the secondary effect of animal keeping is also worth considering. Historically, forest grazing has been very important in Hungary. In modern-day Turkey, for example, goats have played a leading role in exploiting and shaping local woodland environment (Izbirak 1976, 131). Intensive grazing by small ruminants may preclude the recovery of forests, thereby closing the loop between deforestation and sheep/goat keeping leading to the evolution of characteristically open landscapes.

Attitudes to wild and domestic animals

Although the importance of hunting in the Körös culture has consistently been emphasised in the literature, these statements often disregarded assemblage size. It appears that people at major Körös culture settlements in Hungary were deeply involved with sheep and goat keeping: a positive correlation exists between assemblage size and the percentual contribution of domestic animal remains, dominated by the bones of caprines. The role of apparently opportunistic hunting has been overemphasised on the basis of a few, small assemblages. While fowling seems to have been widely practised in the marshland environment, killing large game would have required completely different skills, perhaps more traditionally mustered by Mesolithic populations.

Aside from meat exploitation, apparently, the bones of domestic animals also dominated in the worked bone assemblage from Ecsegfalva 23 (Choyke, chapter 29). Deer especially, seems to have played a more important role as symbol than as a source of meat or raw materials at the Körös culture settlements of both Ecsegfalva 23 and Endrőd 119. Additional attitudes to wild animals in Neolithic Europe have been discussed on the basis of ethnographic observations by Whittle (2003, 82–3).

The enigma of sheep keeping

The presence of both wild and domestic pigs, and to some extent the evidence for limited hunting of red and roe deer, raise the possibility that the settlement at Ecsegfalva 23 may have been similar to a modern 'forest village' (Izbirak 1976, 179), a small agricultural community subsisting in floodplain forest clearings, gradually expanding its fields and animal pasturage. Among large game, the major representation of wild pig and the sporadic occurrence of wild ass bones suggest that the wild fauna differed from those of Körös sites toward the south (especially in Voivodina), located more at the edge of a steppe-like habitat. A largely north to south replacement of wild pig with wild ass may be observed among the wild animal remains of major Körös culture sites *(Fig. 14.18)*. Conclusions drawn from the ecological analysis of bird species are indicative of a 'marshy environment with shallow, but deep water in some places, surrounded by dense reed beds and wet meadow, and scattered shrubs and trees in the vicinity' (Gál, chapter 19).

It remains a major question why the keeping of sheep, and to some extent goat was preferred over that of pig in such a wet environment (Whittle 2003, 91). In terms of the general model measuring the net output of certain domesticates in marginal environments (Bartosiewicz and Choyke 1985), it is evident that pigs would have perfectly met culturally idiosyncratic expectations, if only they formed part of the Körös culture tradition. Caprines seem to have been preferred for largely emotional/cognitive reasons.

Interpreting the Ecsegfalva 23 material within the broader context of other large Körös culture sites seems to suggest that it was actually pastoral communities that may have migrated into the area. The major assemblages used for comparison in this study seem to represent immigration, rather than acculturation of the local Mesolithic populations or the acquisition of sheep by exchange. This opinion seems to be supported by several arguments:

1. The relatively small size of sheep at the sites of Endrőd 119 and Ecsegfalva 23, as well as pathological deformations on the bones of these animals suggest that the caprine population was exposed to environmental stress, largely attributable to the marshy habitat. Insisting on keeping mostly sheep under these circumstances may reflect a strong cultural tradition which only slowly turned into what would today be considered rational adaptation.
2. One may hypothesise that local, Mesolithic communities experimented with keeping sheep acquired from people in the south-east. However, it is likely that they would have been less

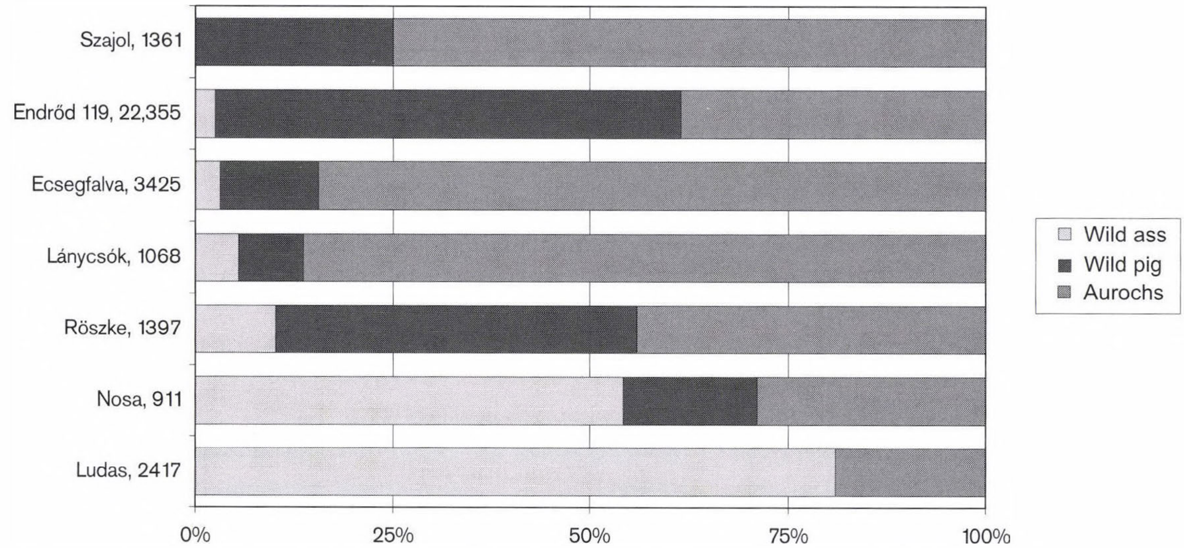


Fig. 14.18. The proportion between three large game species in major Körös culture assemblages

committed to keeping these animals against almost all odds, to the extent that is shown by the consistent dominance of caprine bones (NISP) at typical Körös culture settlements. Given the contradiction between the environment and the habitat requirements of newly domesticated sheep, the massive presence of these animals seems far from 'experimental' and was more likely the result of deeply ingrained cultural traditions.

3. Historical and ethnographic analogies indicate that large herds of sheep can be extremely mobile, both in terms of speed and the number of animals. This would have facilitated 'colonisation' by Neolithic populations from the Balkans.

Although these points have been reconfirmed by the analysis of animal bones from Ecsegfalva, this does not mean that other sites will tell exactly the same story. While the large settlement of Endrőd 119 falls into the same category, smaller sites may yield zoological finds related to more than just opportunistic hunting. Mesolithic human populations and their life styles must have coexisted with early farming settlements in the area, but in the near absence of wild animal remains, the character of the animal bone assemblage from Ecsegfalva 23 is rather indicative of specialised farmers struggling to survive in a new environment.

Acknowledgements

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Appendix Tables

Appendix Table 14.I. Animal remains from Trench 18A

18A	Cattle	Caprine	Pig	Aurochs	Red deer	Wild pig	Large ungulate	Small ungulate	Total
vertebra cervicalis				2					2
vertebra thoracalis	1								1
humerus		2	2			1			5
pelvis	1								1
femur		1							1
Category A	**2**	**3**	**2**	**2**		**1**			**10**
costa	1							1	2
radius		3							3
tibia	1								1
fibula			1	1					2
Category B	**2**	**3**	**1**	**1**				**1**	**8**
dentes	2	1							3
metacarpalia	1			2					3
metatarsalia					1				1
Category C	**3**	**1**		**2**	**1**				**7**
long bone fragment							3	10	13
flat bone fragment								1	1
Non-identifiable									**14**
Total weight, g	**68**	**25**	**21**	**107**	**10**	**56**	**4**	**5**	**296**
Total NISP (A+B+C)	**7**	**7**	**3**	**5**	**1**	**1**	**1**	**1**	**26**
Mean weight, g	**9.7**	**3.6**	**7.0**	**21.4**	**10.0**	**56.0**	**4.0**	**5.0**	**11.8**

Appendix Table 14.II. Animal remains from Trench 23A

23A	Cattle	Sheep	Goat	Caprine	Pig	Dog	Aurochs	Red deer	Wild pig	Red fox	Marten	Hamster	Large ungulate	Small ungulate	Total
axis		1													1
vertebra cervicalis	2			3											5
vertebra thoracalis				1									1		2
vertebra lumbalis	1			4											5
os sacrum				1											1
scapula	1			3					1				2	1	8
humerus	4	3		5			1			1					14
pelvis	6			4										1	11
femur	13			8	1										22
Category A	**27**	**4**		**29**	**1**		**1**		**1**	**1**		**0**	**3**	**2**	**69**
frontale				1											1
neurocranium				3									2		5
mandibula	1			1	1							1			4
costa	7			12				1					9	8	37
radius	4	3	8												15
ulna											1				1
tibia	5	1		17									2	6	31
fibula					1										1
Category B	**17**	**4**	**8**	**34**	**2**			**1**			**1**		**13**	**14**	**95**
horn core/antler			3												3
viscerocranium					1										1
maxilla							1								1
dentes	8			2	1	1								2	14
carpalia	2			3											5
metacarpalia	4	3		3			1								11
phalanx proximalis		1		2					1						4
calcaneus		1													1
astragalus		1													1
metatarsalia	1	1		5											7
Category C	**15**	**7**	**3**	**15**	**2**	**1**	**2**		**1**					**2**	**48**
long bone fragment				4									15	26	45
flat bone fragment													17	13	30
Non-identifiable				**4**									**32**	**39**	**75**
Total weight, g	**1168**	**113**	**59**	**196**	**25**	**2**	**280**	**3**	**13**	**4**	**1**	**0**	**116**	**24**	**2004**
Total NISP (A+B+C)	**59**	**15**	**11**	**78**	**5**	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**16**	**18**	**212**
Mean weight, g	**19.8**	**7.5**	**5.4**	**2.5**	**5.0**	**2.0**	**93.3**	**3.0**	**6.5**	**4.0**	**1.0**	**0.3**	**7.3**	**1.3**	**9.5**

Appendix Table 14.III. Animal remains from Trench 23B

23B	Cattle	Sheep	Goat	Caprine	Pig	Dog	Aurochs	Red deer	Roe deer	Wild pig	Wild ass	Brown hare	Red fox	Weasel	Hedgehog	Large ungulate	Small ungulate	Total
atlas	3	12		17			1			1			1					35
axis	5	8		8					2									23
vertebra cervicalis	12			110		1	3	2	1			1	3			6	8	147
vertebra thoracalis	28			129	1	1	7	3					8			12	34	223
vertebra lumbalis	17			117	1	2	3	1	1			1	8			4	2	157
os sacrum	1			10									1			1	3	16
vertebra caudalis	1			8									1					10
sternum	1			6	1	1										2		11
scapula	19	24		91	2	1	4	1	3	1		2	3	1	1	13	15	181
humerus	26	36		139		3	1		3	1			1			7	6	223
pelvis	17	2		81	1	1	2	1	2				1			5	3	116
femur	26	11		225	5	1	2	1	3			3	1		1	17	15	311
Category A	**156**	**93**	**0**	**941**	**11**	**11**	**23**	**9**	**15**	**3**	**0**	**7**	**28**	**1**	**2**	**67**	**86**	**1453**
frontale	10	3		8	4				1									26
neuro-cranium	11	7		134	4	1	4		1	1			2			8	41	214
mandibula	23	25		172	4	1	13	1	5	2			4			6	1	257
linguale	1			2														
costa	55			531	4	4	8					9	15			185	593	1406
radius	12	28	3	77	4		8	1	3			1	3				1	141
ulna	5	6		55	1		3		1			1	1					73
patella	6	1		2														9
tibia	42	14		402	7	3	8	2	4	1		1	1				30	515
fibula					4								2					6
Category B	**165**	**84**	**3**	**1383**	**32**	**9**	**44**	**4**	**15**	**4**	**0**	**12**	**28**	**0**	**0**	**199**	**666**	**2648**
horn core/antler	**5**	**3**	**2**															10
viscero-cranium	4	1		51	1		3						1					61
maxilla	5	4		36	2	1											1	49
dentes	17	1		186	7	1	3	3	18	1						5	10	252
carpalia	6			29			4	1				2						42
meta-carpalia	11	79	4	86	5	1	5	4	8	2	2	3	4			5	1	220
phalanx proximalis	11	7		131	5	3	10	1	4	4	1	1	7					185
phalanx media	12	1		62	2		5	2	5			1	5					95
phalanx distalis	1	6		25		1	5	2	4	2								46

Appendix Table 14.III. Continued

23B	Cattle	Sheep	Goat	Caprine	Pig	Dog	Aurochs	Red deer	Roe deer	Wild pig	Wild ass	Brown hare	Red fox	Weasel	Hedgehog	Large ungulate	Small ungulate	Total
sesam-oideum	2																	2
calcaneus	4	10		12		1	1		1	1								30
astragalus	5	27		6		1	4	1	3			1						48
centro-tarsale	3	8		4	1				1									17
meta-tarsalia	29	84		115		1	10	3	6	2		5	3				7	265
Category C	**115**	**231**	**6**	**743**	**23**	**10**	**50**	**17**	**50**	**12**	**3**	**13**	**20**	**0**	**0**	**10**	**19**	**1322**
long bone fragment				66												223	4121	4410
flat bone fragment				15												228	3206	3449
Non-identifiable				**81**												**451**	**7327**	**7859**
*antler n. id.								3	2									5
Total weight, g	**9601**	**3636**	**92**	**6902**	**397**	**61**	**6652**	**537**	**441**	**665**	**23**	**258**	**165**	**1**	**1**	**2086**	**1624**	**33142**
Total NISP (A+B+C)	**436**	**408**	**9**	**3067**	**66**	**26**	**117**	**30**	**80**	**19**	**2**	**32**	**80**	**1**	**2**	**276**	**4651**	**5422**
Mean weight, g	**22.0**	**8.9**	**10.2**	**2.3**	**6.0**	**2.3**	**56.9**	**17.9**	**5.5**	**35.0**	**11.5**	**8.1**	**2.1**	**1.0**	**0.5**	**7.6**	**2.1**	**6.1**

* Possibly shed antler

Appendix Table 14.IV. Animal remains from Trench 23C

23C	Cattle	Sheep	Goat	Caprine	Pig	Dog	Aurochs	Roe deer	Wild pig	Red fox	Large ungulate	Small ungulate	Total
atlas				1									1
axis		2											2
vertebra cervicalis	4			8			1		1			1	15
vertebra thoracalis	2			7			1		1			1	12
vertebra lumbalis	4			3			1			1			9
os sacrum	1			1							2		4
vertebra caudalis	1			1									2
scapula	2			3									5
humerus		5		7			1				1		14
pelvis				3							1		4
femur	2	2		13			1						18
Category A	**16**	**9**		**47**			**5**		**2**	**1**	**4**	**2**	**86**
frontale		1											1
neurocranium	4			8	1							1	14
mandibula	2			12	1		4						19
costa	9			26			2				10	32	79
radius	2	2		1									5
ulna				1									1
tibia	4	1		1					3				9
fibula				1									1
Category B	**21**	**4**		**50**	**2**		**6**		**3**		**10**	**33**	**129**
viscerocranium	1			6	1								8
maxilla		1		4	1				1				7
dentes	7			10	5			1					23
carpalia	2			3			2						7
metacarpalia	2	3	1	4					5				15
phalanx proximalis	3			8		1		1	1	1			15
phalanx media		1		2	2								5
phalanx distalis				4									4
calcaneus	1	2								1			4
astragalus		4											4
centrotarsale	1												1
metatarsalia	3	4		3					1				11
Category C	**20**	**15**	**1**	**44**	**9**	**1**	**2**	**2**	**8**	**2**			**104**
long bone fragment				2							14	38	
flat bone fragment											21	109	
Non-identifiable				**2**							**35**	**147**	
Total weight, g	**1016**	**275**	**18**	**435**	**62**	**2**	**821**	**3**	**208**	**5**	**171**	**137**	**3153**
Total NISP (A+B+C)	**57**	**28**	**1**	**141**	**11**	**1**	**13**	**2**	**13**	**3**	**14**	**35**	**319**
Mean weight, g	**17.8**	**9.8**	**18.0**	**3.1**	**5.6**	**2.0**	**63.2**	**1.5**	**16.0**	**1.7**	**12.2**	**1.0**	**9.9**

Appendix Table 14.V. Rodent remains from Ecsegfalva 23

	23A			23B				23C		
	Souslik	Vole	Rodent non-id.	Souslik	Hamster	Vole	Rodent non-id.	Vole	Rodent non-id.	Total
atlas				1			5			**6**
axis						1				**1**
vertebra cervicalis					17	4	113	1		**135**
vertebra thoracalis				3	7		59			**69**
vertebra lumbalis				2	10	2	80			**94**
scapula					14	2	1			**17**
humerus			1	9	53	11	10			**84**
pelvis				5	29	2	9			**45**
femur		1			48	9	20			**78**
Category A		**1**	**1**	**20**	**178**	**31**	**297**	**1**		**529**
frontale				1						**1**
neurocranium				1						**1**
mandibula	1			28						**29**
costa			1		2		2			**5**
radius				2	14	2	7			**25**
ulna				3	20	4	5			**32**
tibia				9	55	7	37		1	**109**
fibula					1					**1**
Category B	**1**		**1**	**44**	**92**	**13**	**51**		**1**	**203**
viscerocranium										
maxilla				5				1		**6**
dentes				5						**5**
carpalia										
metacarpalia					6	1	2			**9**
phalanx proximalis					2					**2**
calcaneus										
astragalus										
metatarsalia					2					**2**
Category C				**10**	**10**	**1**	**2**	**1**		**24**
Total NISP (A+B+C)	**1**	**1**	**2**	**74**	**280**	**45**	**350**	**2**	**1**	**756**

Appendix Table 14.VI. Mammalian bone measurements.
All measurements after von den Driesch 1976, excl. Sd = smallest depth of the diaphysis.
Notes: *cheektooth row in mandibula; **greatest breadth in vertebrae and medial length in astragalus; ***Length and width of 3rd molar

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
CATTLE											
scapula	left	adultus	23B	327					35.5	38.2	54.6
scapula	right	maturus	23B	431					54.1	48.5	68.2
humerus	right	adultus	23B	526				25.5	28.1	69.3	69.1
radius	left	subadultus	23B	495						40.3	36.9
radius	right	subadultus	23B	343		59.8	32.0				
metacarpus	left	maturus	23A	102						61.1	29.9
metacarpus	left	maturus	23A	103		54.0	34.1				
metacarpus	right	maturus	23A	102						69.9	37.2
phalanx proximalis		maturus	23B	344	51.2	28.2	31.0	23.2	20.0	27.1	21.1
phalanx proximalis		maturus	23B	367	57.2	31.1	33.1				
phalanx proximalis		maturus	23B	423	62.8	40.2	43.1				36.9
phalanx proximalis		n. a.	23B	354	57.0	33.2	35.7				29.0
phalanx proximalis		n. a.	23B	344						32.5	24.3
phalanx proximalis		n. a.	23B	354	61.2	31.2	35.3	28.1	21.0	31.4	23.3
phalanx proximalis		subadultus	23B	356	60.0	33.0	37.1	31.0	22.0	32.8	25.2
phalanx proximalis		adultus	23B	439	61.5	31.5	35.0	28.2	21.8	32.0	23.5
phalanx proximalis		maturus	23B	301	61.5	30.6	34.8	27.0	20.4	30.7	22.6
phalanx proximalis		maturus	23B	344	63.9	29.0	33.5	25.2	19.8	29.5	21.0
phalanx proximalis		maturus	23C	534	59.1	32.2	36.1	29.1	21.1	32.0	24.1
phalanx media		maturus	23B	397	43.1	31.8	32.2				
femur	right	maturus	23B	313		96.8	45.8				
femur	left	maturus	23C	542	371.2	99.5	47.2			99.9	122.2
tibia	right	maturus	23B	344						65.0	51.9
tibia	right	maturus	23B	313						62.8	48.7
tibia	right	maturus	23B	301						60.8	45.2
tibia	left	maturus	23B	423						56.7	44.5
tibia	left	maturus	23A	102						62.0	43.6
astragalus	right	maturus	23B	431	76.8	67.9				45.7	40.9
astragalus	right	maturus	23B	431		60.6				40.0	37.1
calcaneus	left	maturus	23C	931	128.3					39.0	45.2
metatarsus	right	maturus	23B	351		52.1					
metatarsus	left	subadultus	23C	526						45.7	29.9
metatarsus	left	subadultus	23B	445						41.1	27.9
metatarsus	left	adultus	23C	533		43.2		20.0	22.0	46.2	31.0
metatarsus	right	subadultus	23B	457						52.6	31.1
SHEEP											
lower M3	right	maturus	23B	307						20.2	7.5
lower M3	right	maturus	23C	520						22.2	8.9
lower M3	left	maturus	23B	320						23.3	8.5
axis		maturus	23B	497		40.7					
axis		maturus	23C	524		38.1					
axis		maturus	23C	532	59.0	45.6					

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
atlas		maturus	23B	376	41.9	51.5					
atlas		maturus	23B	464	39.9	55.2					
atlas		maturus	23B	301	38.0	54.0					
scapula	left	maturus	23B	373					14.2	15.0	25.1
scapula	left	adultus	23B	496					17.2	19.2	29.0
scapula	right	maturus	23B	340					17.2	18.9	29.1
scapula	right	adultus	23B	497					14.9	17.3	25.0
scapula	right	maturus	23B	442					17.8	18.1	25.2
scapula	right	adultus	23B	371					17.2	18.7	28.0
scapula	right	maturus	23B	407					19.0	20.7	30.1
scapula	left	subadultus	23B	407					14.9	18.1	28.4
scapula	right	maturus	23B	410					17.9	18.9	31.0
scapula	right	subadultus	23B	340					16.0	17.2	29.1
scapula	right	maturus	23B	327					18.2	21.1	21.1
scapula	left	maturus	23B	327					19.0	19.3	32.6
scapula	left	maturus	23B	340					20.2	20.9	32.5
scapula	left	maturus	23B	340					20.3	20.8	33.1
scapula	left	maturus	23B	300					16.9	19.2	29.2
scapula	left	adultus	23B	439					14.1	16.1	27.8
scapula	right	adultus	23B	367					15.2	16.2	26.1
humerus	right	subadultus	23B	396				13.1	13.0	26.0	22.8
humerus	left	maturus	23B	342					25.5	22.1	
humerus	left	maturus	23B	422						26.4	24.4
humerus	left	subadultus	23B	396				11.0	11.3	23.9	21.6
humerus	right	adultus	23B	308						26.8	
humerus	right	maturus	23B	396				11.8	11.7	23.9	22.0
humerus	left	maturus	23B	464				14.1	12.9	26.9	22.1
humerus	right	maturus	23B	376				14.2	13.0	26.0	23.5
humerus	left	subadultus	23B	358				10.0	11.1	22.1	20.1
humerus	left	maturus	23B	342				13.4	14.0	27.2	24.1
humerus	left	maturus	23B	321				13.2	12.9	26.9	20.1
humerus	right	maturus	23B	445						27.0	23.0
humerus	right	maturus	23B	314						26.8	24.1
humerus	right	adultus	23B	465				12.0	13.0	25.2	22.1
humerus	left	maturus	23B	311				12.3	13.1	26.9	22.0
humerus	left	maturus	23A	109						29.2	27.2
humerus	right	maturus	23B	301						26.0	23.1
humerus	right	adultus	23B	445						24.5	18.0
humerus	left	maturus	23B	301				10.7	11.0	23.1	20.3
humerus	left	adultus	23B	424				11.1	12.1	26.0	21.0
humerus	left	maturus	23B	307				13.6	13.5	26.8	21.8
humerus	right	maturus	23A	103						26.1	23.5
humerus	right	maturus	23B	301						26.1	19.1
humerus	right	maturus	23B	476						24.1	21.1
humerus	left	maturus	23B	314				12.2	11.1	25.0	22.0

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
humerus	left	maturus	23B	396				14.0	13.8	26.0	22.4
humerus	right	maturus	23B	356				14.2	13.8	27.0	22.8
humerus	right	maturus	23B	327	122.8			14.2	14.8	26.8	24.1
humerus	left	maturus	23B	340				14.0	14.8	27.1	23.0
humerus	right	maturus	23B	354						28.2	22.8
humerus	left	maturus	23B	424						26.5	24.0
humerus	left	adultus	23B	341				9.2	10.0	22.5	19.9
humerus	right	maturus	23B	345						29.0	21.5
humerus	right	subadultus	23A	129						21.9	18.6
humerus	right	maturus	23B	445						24.8	21.0
humerus	left	maturus	23C	528						25.2	23.0
humerus	right	maturus	23C	542						29.2	26.2
humerus	right	subadultus	23C	530						23.0	21.0
humerus	left	maturus	23C	0				11.1	11.9	22.9	20.9
radius	right	subadultus	23B	457		24.9	12.1	13.1	6.1	22.0	14.5
radius	left	subadultus	23B	376						25.8	18.0
radius	right	subadultus	23B	356		24.9	13.8				
radius	left	adultus	23B	356		25.8	13.2	13.1	7.5	22.1	14.2
radius	right	subadultus	23B	464		25.2	14.1	13.2	7.0	24.0	17.2
radius	right	maturus	23B	314		28.1	14.2	14.0	8.1		15.6
radius	left	adultus	23B	344						26.1	18.2
radius	left	adultus	23B	327		27.0	13.1	14.6	8.1	23.2	15.2
radius	left	maturus	23B	464	134.7	27.2	14.1	14.5	7.6	25.2	15.9
radius	left	adultus	23B	354		28.1	14.1	15.4	7.2		
radius	left	adultus	23B	314		26.1	13.1	13.6	7.0	23.2	15.1
radius	right	adultus	23B	442		25.8	13.4	14.1	7.1		
radius	left	maturus	23B	445		28.0	14.6	16.2	7.9	23.2	16.0
radius	left	maturus	23B	422		29.2	14.1				
radius	left	maturus	23B	445						26.0	18.2
radius	right	maturus	23B	457		29.0	14.9				
radius	left	adultus	23B	371						27.2	18.0
radius	right	maturus	23B	301						24.9	17.1
radius	right	maturus	23B	314		26.2	12.6				
radius	left	maturus	23B	301		28.2	15.1				
radius	right	maturus	23B	356		29.9	15.3				
radius	left	maturus	23B	356		27.1	13.1	15.2	8.2		
radius	left	adultus	23B	369						26.5	18.1
radius	right	adultus	23B	369		27.8	14.5	14.9	7.7	25.0	17.4
radius	left	adultus	23B	316						26.5	17.2
radius	right	maturus	23B	340		27.1	14.2	14.0	7.2		
radius	left	maturus	23A	103		30.0	14.2				
radius	left	maturus	23B	445	138.7	28.2	14.3	14.3	7.2	25.0	16.9
radius	left	maturus	23C	537						24.0	16.0
radius	left	maturus	23A	134		27.7	13.9				
radius	right	maturus	23C	542						28.0	19.2

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
radius	right	maturus	23B	473						25.8	17.1
metacarpus	left	adultus	23B	300		19.3	14.5				
metacarpus	left	maturus	23B	340	114.1	18.9	14.0	12.0	17.9	21.4	14.1
metacarpus	left	subadultus	23B	301						24.1	14.8
metacarpus	left	juvenilis	23B	330		18.9	13.5	11.1	8.9	23.9	14.9
metacarpus	left	maturus	23B	321					7.8	21.0	14.0
metacarpus	left	maturus	23B	354						21.2	13.9
metacarpus	left	adultus	23B	466						23.5	12.7
metacarpus	left	maturus	23B	464				12.0	8.0	21.5	14.1
metacarpus	left	subadultus	23B	301		19.8	13.7	12.5	9.3	23.9	14.0
metacarpus	right	maturus	23B	342		20.1	15.0	11.9	20.4		
metacarpus	left	juvenilis	23B	340				10.7	7.9	19.1	13.1
metacarpus	left	subadultus	23B	313						23.5	14.7
metacarpus	left	maturus	23B	435	105.7	18.4	13.5	12.1	7.5	21.1	13.5
metacarpus	left	adultus	23B	464						21.9	15.0
metacarpus	left	maturus	23B	445		20.2	14.4	12.2	8.5		
metacarpus	right	maturus	23B	301		21.5	15.1	13.1	9.3		
metacarpus	left	subadultus	23B	340						22.5	11.9
metacarpus	right	maturus	23B	356	118.9	19.3	14.1	12.0	8.1	21.9	14.1
metacarpus	left	subadultus	23B	311						23.9	14.4
metacarpus	right	maturus	23B	427		18.2	13.0				
metacarpus	left	maturus	23B	464						21.8	14.5
metacarpus	left	maturus	23B	445	113.1	19.3	14.2	12.7	8.2	22.5	13.8
metacarpus	right	maturus	23B	301			18.3	14.2			
metacarpus	left	maturus	23B	445						21.9	14.2
metacarpus	left	maturus	23C	543						25.2	15.3
metacarpus	right	maturus	23C	530	117.0	21.5	15.0	13.5	8.9	25.2	15.2
metacarpus	left	maturus	23A	103		20.2	14.1				
metacarpus	left	maturus	23A	103		19.0	12.9	11.5	9.1		
metacarpus	right	maturus	23B	445	120.0	20.2	15.2	12.6	8.2	21.8	14.9
femur	left	maturus	23C	538						35.7	40.8
femur	right	maturus	23B	316						32.2	40.2
femur	right	maturus	23C	546	164.3	42.0	20.8	16.0	15.2	36.0	44.4
femur	left	maturus	23B	300						42.1	
femur	left	maturus	23B	497						35.8	50.9
femur	left	maturus	23B	461						31.0	39.2
femur	left	maturus	23B	308		41.1	18.9				
femur	right	maturus	23B	340		43.0	20.8				
femur	right	maturus	23B	464		41.1	29.9				
femur	right	subadultus	23B	416						31.5	39.5
femur	right	embryo	23B	529	22.0						
tibia	right	embryo	23B	529	30.0						
tibia	left	maturus	23B	486						21.1	18.1
tibia	left	adultus	23B	354						23.8	18.9
tibia	left	maturus	23B	461						24.2	19.8

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
tibia	left	maturus	23B	343						26.5	20.0
tibia	right	subadultus	23B	350		34.2	36.7				
tibia	left	adultus	23B	371		35.0	32.2				
tibia	right	n. a.	23B	601		37.9	38.1				
tibia	right	maturus	23B	472						28.2	22.4
tibia	left	maturus	23B	340				11.1	9.5	20.0	17.2
tibia	left	subadultus	23B	307						22.9	16.8
tibia	left	maturus	23B	356				14.2	12.1	23.9	17.8
tibia	left	maturus	23B	301						23.1	18.0
tibia	right	maturus	23C	532						25.8	21.0
tibia	right	adultus	23A	126						21.2	17.5
astragalus	left	neonatus	23B	333	16.1	14.9				11.0	9.3
astragalus	right	maturus	23B	445	23.9	22.9				16.0	14.0
astragalus	left	maturus	23B	461	26.6	24.0				16.1	14.9
astragalus	left	maturus	23B	457	28.0	26.5				16.1	15.5
astragalus	left	maturus	23B	442	27.1	24.9				17.2	15.0
astragalus	right	maturus	23B	439	26.9	24.0				26.9	14.6
astragalus	right	maturus	23B	431	26.9	24.8				17.1	14.8
astragalus	left	maturus	23B	430	23.1	22.9				14.5	13.1
astragalus	left	maturus	23B	445	32.4	31.0				21.1	18.0
astragalus	left	subadultus	23B	356	23.8	23.2				14.9	14.1
astragalus	left	adultus	23B	350	24.1	22.2				14.9	12.7
astragalus	right	n. a.	23B	496	25.8	24.2				16.9	14.9
astragalus	right	maturus	23B	445	24.9	23.0				16.0	14.0
astragalus	right	maturus	23B	320	27.2	25.8				16.1	15.0
astragalus	right	maturus	23B	330	24.1	22.1				15.2	13.2
astragalus	left	maturus	23B	330	26.8	25.8				17.1	15.2
astragalus	left	maturus	23B	369	24.1	24.0				15.8	13.9
astragalus	left	maturus	23B	307	27.5	25.3				17.2	15.8
astragalus	left	maturus	23B	307	27.2	26.0				16.2	14.9
astragalus	left	adultus	23B	300	23.2	23.0				14.8	13.1
astragalus	right	subadultus	23A	129	25.1	25.0				15.1	14.0
astragalus	right	maturus	23B	301	25.2	23.9				16.2	14.1
astragalus	right	adultus	23B	301	24.1	22.5				15.2	13.1
astragalus	left	adultus	23B	354	23.0	22.1				15.4	13.5
astragalus	left	adultus	23B	302	25.2	23.0				15.8	14.1
astragalus	left	maturus	23B	321	23.8	22.1				15.9	13.2
astragalus	left	maturus	23B	421	25.0	24.0				16.1	14.8
astragalus	right	adultus	23C	532	28.9	27.2				17.3	15.0
astragalus	right	maturus	23C	532	28.3	26.9				18.9	15.1
astragalus	left	adultus	23C	538	31.0	29.0				18.1	17.0
astragalus	left	maturus	23C	538	32.0	30.8				21.0	18.1
calcaneus	right	maturus	23C	520	49.9					18.2	18.0
calcaneus	right	maturus	23B	307	50.2					17.6	18.5
calcaneus	right	maturus	23B	301	64.1					19.9	24.3

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
calcaneus	right	maturus	23C	532	55.3					18.2	22.1
metatarsus	right	embryo	23B	529	21.5						
metatarsus	right	n. a.	23B	308	43.5						
metatarsus	left	adultus	23B	445		18.9	19.5	11.1	9.0	20.3	13.8
metatarsus	left	subadultus	23B	430						19.9	12.9
metatarsus	right	maturus	23B	445		17.0	17.8	10.8	9.0	20.3	12.9
metatarsus	left	maturus	23B	445				11.4	7.2	20.7	13.2
metatarsus	right	maturus	23B	445		18.2	18.3				
metatarsus	right	maturus	23C	528	121.1	21.1	20.9	12.3	9.8	24.0	15.2
metatarsus	right	subadultus	23C	532	116.5	21.1	20.9	12.0	9.6	23.6	15.5
metatarsus	left	maturus	23B	301						22.2	15.1
metatarsus	left	maturus	23B	300		19.0	19.1	10.6	9.0		
metatarsus	left	adultus	23A	144						19.4	14.3
metatarsus	left	subadultus	23B	431						20.2	13.5
metatarsus	left	maturus	23B	316		17.9	18.9				
metatarsus	right	maturus	23B	344		18.5	18.5				
metatarsus	left	maturus	23B	301					0.0	26.1	17.2
metatarsus	left	maturus	23B	430				11.2	7.9	21.4	14.2
metatarsus	right	maturus	23B	430				9.9	8.1	20.9	13.9
metatarsus	right	maturus	23B	317		18.9	18.0				
metatarsus	right	adultus	23B	423		17.2	17.2	10.2	7.9		
metatarsus	right	n. a.	23B	354		17.6	18.0				
metatarsus	left	subadultus	23B	307						22.2	14.9
metatarsus	right	maturus	23B	314						20.3	14.1
metatarsus	left	subadultus	23B	376						23.2	13.9
metatarsus	left	maturus	23B	313		19.9	19.2				
metatarsus	right	maturus	23B	330		18.2	18.1				
metatarsus	left	maturus	23B	416	125.0	17.9	19.4	11.1	9.1		
metatarsus	left	n. a.	23B	301		17.4	18.2				
metatarsus	right	adultus	23B	300		18.1	18.0	10.9			
metatarsus	left	maturus	23B	473		19.0	20.0				
metatarsus	right	maturus	23B	307		19.8	19.9				
metatarsus	right	juvenilis	23B	313						21.1	13.1
metatarsus	right	maturus	23B	307		18.2	19.1				
metatarsus	right	maturus	23B	336		18.1	17.2				
metatarsus	right	maturus	23B	340		18.9	19.9				
GOAT											
radius	right	adultus	23B	336		24.1	13.8	14.8	7.9	25.9	17.2
radius	right	adultus	23B	445		25.6	14.3	15.0	8.0		
metacarpus	left	adultus	23C	524		21.1	15.2	13.6	9.9		
PIG											
radius	right	maturus	23B	371		30.7	22.1				
tibia	right	subadultus	23B	327		36.8	29.0				
DOG											
scapula	left	adultus	23B	445						15.2	26.0

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
humerus	left	maturus	23B	443	133.1	17.0	24.1	7.5	7.9	21.0	15.6
humerus	right	maturus	23B	427	135.2	20.0	26.1	7.6	7.8	21.1	16.2
radius	right	maturus	23B	427		12.7	8.1				
radius	left	maturus	23B	443						15.5	8.9
radius	right	maturus	23B	427		12.0	8.1				
femur	left	maturus	23B	481				10.0	8.2	20.5	22.2
femur	right	maturus	23B	443	141.0	26.2	12.5	9.1	8.7	21.8	23.2
tibia	right	maturus	23B	427	154.0	23.2	24.8	8.0	8.0	16.0	11.2
astragalus	left	maturus	23B	313	24.5					16.1	
AUROCHS											
lower M3	left	maturus	23B	430		97.2				41.5	15.0
lower M3	right	maturus	23B	344						41.0	16.9
scapula	left	maturus	23B	465						48.9	73.0
metacarpus	right	maturus	23B	464		80.7	47.6				
phalanx proximalis		maturus	23B	351	77.2	41.9	42.0	35.8	25.9	38.2	30.2
phalanx proximalis		maturus	23B	465	73.8	40.0	41.3				
phalanx proximalis		maturus	23B	320	73.7	39.6	40.2	33.8	25.2	36.2	33.0
phalanx proximalis		adultus	23B	327	77.2	41.9	42.0	35.8	25.9	38.2	30.2
phalanx proximalis		maturus	23B	423	70.2	37.3	38.1	31.8	24.5	34.1	35.8
phalanx proximalis		maturus	23B	423	73.7	39.0	39.8	33.7	25.0	35.8	32.9
phalanx proximalis		maturus	23B	464	74.0	41.2	43.0	34.2	26.3	37.0	34.1
phalanx proximalis		maturus	23B	422	74.2	40.1	40.9				
phalanx proximalis		maturus	23B	0						36.3	33.2
phalanx proximalis		maturus	23B	328	71.0	37.5	38.0	31.5	23.8	34.0	35.5
phalanx media		maturus	23B	396	44.1	35.2	36.0				
phalanx distalis		maturus	23B	301	99.0						
femur	left	maturus	23B	313		134.2					
tibia	left	maturus	23B	445						77.0	61.5
tibia	left	maturus	23B	461						75.0	60.0
astragalus		maturus	23B	351	76.1	67.0				48.2	42.0
astragalus	left	maturus	23B	445	79.0	73.1				50.0	43.2
astragalus	left	maturus	23B	431	76.1	71.0				45.2	40.8
calcaneus	right	adultus	23B	342						48.2	54.9
metatarsus	right	maturus	23B	351		53.9	49.1				
metatarsus	left	adultus	23B	356						74.8	41.5
metatarsus		adultus	23B	432						67.0	36.5
RED DEER											
lower M3	left	maturus	23B	432						33.6	14.1
astragalus	left	maturus	23B	421	62.5	58.1				38.1	33.9
ROE DEER											
shed antler rosa		adultus	23B	301		34.5	26.8				
scapula	left	maturus	23B	301						18.5	
scapula	left	maturus	23B	356					18.0	21.1	27.9
scapula	left	maturus	23B	320						21.1	30.9
scapula	right	maturus	23B	464					16.5	18.7	28.2

Appendix Table 14.VI. Continued

	Side	Age	Area	Context	GL*	Bp**	Dp	SD	Sd	Db***	Dd***
humerus	right	maturus	23B	352						30.4	28.1
humerus	left	maturus	23B	308				13.8	12.0	26.8	23.1
metacarpus	right	juvenilis	23B	343		16.7	12.0				
metacarpus	left	maturus	23B	423		21.8	16.1				
tibia	left	maturus	23B	423						28.4	23.5
tibia	left	maturus	23B	352				13.6	12.0	24.9	21.1
astragalus	left	maturus	23B	423	26.0	24.1				16.8	15.0
astragalus	left	maturus	23B	321	26.9	24.9			16.1	14.9	
astragalus	left	adultus	23B	423	26.1	23.6				15.2	14.5
shed antler	right	maturus	23B	327		26.9	29.0	20.6	19.1		
WILD PIG											
upper M3	left	senilis	23C	537		82.0				40.0	21.0
atlas		senilis	23B	313		107.2					
scapula	left	maturus	23B	330					33.6	34.9	50.9
humerus	left	maturus	18A	104						39.2	37.6
phalanx proximalis		maturus	23B	359	50.1	26.9	25.5	18.1	14.8	22.1	16.1
calcaneus	left	maturus	23B	354	98.1					28.1	36.1
BROWN HARE											
scapula	left	maturus	23B	430					9.0	12.0	18.0
scapula	left	maturus	23B	497					9.9	11.9	18.7
radius	left	maturus	23B	445		10.4	6.9				
femur	left	adultus	23B	445						22.1	24.0
tibia	left	maturus	23B	461						17.2	10.9
RED FOX											
scapula	right	maturus	23B	427					15.9	11.5	18.7
tibia	left	maturus	23B	470						13.9	10.1
ulna	right	maturus	23B	427	152.0						
HEDGEHOG											
scapula	left	maturus	23B	369	40.2						
femur	left	maturus	23B	464	48.1	11.9	5.4	3.8	3.2	9.8	8.1

Chapter 15

ANCIENT DNA ANALYSIS OF AUROCHSEN

Ceiridwen J. Edwards and *Daniel G. Bradley*

Introduction

During the Middle and Upper Pleistocene, aurochsen (*Bos primigenius*) were widespread throughout the Old World, and three continental races have been identified: *B. primigenius primigenius* (Europe), *B. p. namadicus* (Asia) and *B. p. opisthonomus* (North Africa). Analysis of mitochondrial (mt) DNA approximates that the first two races diverged between 275,000–117,000 years ago, with separation occurring between the European and African sub-types around 26,000–22,000 years (Bradley *et al.* 1996). *B. p. primigenius* and *B. p. namadicus* are thought to have each provided the source population for the two types of modern domestic cattle, giving rise to taurine (*B. taurus*) and Asian zebu (*B. indicus*) cattle, respectively. Within the former case, there is sufficient evidence, from the disciplines of both archaeology (Clutton-Brock 1989; Grigson 1991; Wendorf and Schild 1994) and genetics (Bradley *et al.* 1996; MacHugh *et al.* 1997; Troy *et al.* 2001), to suggest that *B. p. primigenius* gave rise to the European *B. taurus*, and *B. p. opisthonomus* gave rise to the African *B. taurus*.

Bailey *et al.* reported the first instance of amplifiable DNA from aurochs in 1996. They generated 214 bp of reproducible control region mtDNA from two British Pleistocene *B. p. primigenius* cave remains, radiometrically dated to 12,380–10,860 years. The British aurochs sequences were found to cluster more closely with extant taurine samples than with zebu animals and, when a greater number of extant taurine cattle were included in the analysis, the aurochsen grouped more closely with European than African *B. taurus*. The two sequences generated were very similar to each other, with only one base difference over the entire fragment, but, due to the small sample size, it was impossible to determine if this represented a frequent Pleistocene lineage now extinct in modern taurine cattle populations.

Further analysis of aurochsen DNA was undertaken by Troy *et al.* (2001), who analysed 201 bp of the control region mtDNA in four more British aurochs from cave deposits, this time radiocarbon dated to between 7,570 and 3,720 BP. These sequences were found to cluster tightly and were again distinct from modern cattle, despite their spatial and temporal dispersal. The difference between the root of the extant *B. taurus* and the putative root of the aurochsen was eight transitions, and one sample was found to have an identical sequence to one generated by Bailey *et al.* (1996).

Materials and methods

Five *B. p. primigenius* bones from Ecsegfalva 23B were assessed for survival of ancient DNA *(Table 15.1)*. These remains had been differentiated as wild aurochs, rather than domestic cattle, on the basis of size (László Bartosiewicz, *pers. comm.*). The samples were prepared using the procedure modified from Yang *et al.* (1998), as described in MacHugh *et al.* (2000).

Table 15.1. Table of archaeological B. primigenius samples studied, with associated codes and skeletal element used. The final two columns indicate which samples gave reproducible DNA with each of the two control region fragments

Lab Code	Archaeological Code	Skeletal Part	DNA Present	
			157 bp fragment	176 bp fragment
H1	23B 301 3089 E2	carpal	yes	no
H2	23B 314 4334 F3	distal phalanx	inhibition	inhibition
H3	23B 327 5002 E7	distal phalanx	yes	yes
H4	23B 301 3792 D4	os sacrum	no	no
H5	23B 302 3028 C6/D6/C7	os centrotarsale	yes	no

Two overlapping fragments, of 157 bp and 176 bp, were targeted from a defined, highly variable region of the mtDNA control region between bases 16,022 and 16,334 (Loftus *et al.* 1994). All primers were species-specific and so did not amplify human DNA. Ancient PCR set-up was conducted in a laboratory dedicated solely to pre-amplification ancient work. PCR conditions were as described in MacHugh *et al.* (1999), and the resulting amplification products sequenced by Oswel.

Second-round PCR was not undertaken on any samples that did not amplify in the first-round. All non-amplifiable samples were tested for presence of inhibitors that may have been impeding PCR amplification of endogenous DNA. This involved spiking each negative sample extract with pig DNA (from 6,000 BP Carsington Pasture Cave) in a ratio of 1:4. PCR was then continued with primers targeting a region of the pig control region mtDNA. Those samples that yielded a product from the spiked sample were then designated as containing little or no endogenous DNA.

The criteria for authenticating mitochondrial haplotypes were as follows. For working samples, at least two independent extractions were undertaken from those samples that produced amplifiable DNA. Subsequently, a range of PCR amplifications and subsequent sequencing analyses were performed from each purified DNA extract. Reproducible samples were designated as those that gave consistent sequences in three or more amplifications, with at least one result from each of two separate extractions. In order to be considered authentic, any mutations observed had to be replicated in sequences from two separate extracts. The mtDNA sequences thus derived from each sample were therefore verified through independent extractions, amplifications and sequence determinations.

Results

Amplification was attempted for two overlapping fragments (157 bp and 176 bp) of the control region in five aurochs bones from Hungary, leading to a total segment length of 272 bp. Sample details are shown in *Table 15.1.* Amplification of the whole 272 bp product was successful in one sample (H3), with a further two samples (H1 and H5) yielding the 157 bp product alone, an overall success rate of 60%. H3 showed signs of containing substances inhibitory to successful PCR amplification, while H4 had little or no endogenous DNA present. Sequences obtained were compared to the corresponding region amplified from the six previously analysed aurochsen (Bailey *et al.* 1996; Troy *et al.* 2001), from which the putative ancestral British aurochs sequence had been determined (GENBANK accession number AF336746).

The two 157 bp sequences obtained from H1 and H5 were identical to the putative ancestral sequence, while the 272 bp sequence from H3 showed two mutations difference (one transition and one transversion) from this central haplotype. The sequences reported in this chapter were deposited in the GenBank database (accession nos. DQ915549–DQ915551), and further analyses of these samples were undertaken by Edwards *et al.* (2007).

Discussion

All three of the control region sequences obtained from the five Hungarian aurochs remains sampled could be described as *aurochs-like* when compared to data from two British Pleistocene aurochs. Previously only seen in aurochs from Britain, the presence of these sequences in samples from Hungary supports the presence of the aurochs haplogroup across Europe in the Neolithic.

Several diverse haplotypes may have been present in aurochsen prior to the last glaciation, encompassing both the *B. p. primigenius* sampled here and previously, the taurine haplotypes captured by domestication, and possibly other, as yet unsampled, haplotypes. Although the aurochs variants in the Near East would not have been affected by the ice ages of the Quaternary, those populations in Northern Europe would have been forced into different glacial refugia, followed by separate post-glacial colonisation routes, leading to possible genetic subdivision (Hewitt 2000). It is probable that these aurochs populations recolonised Europe from a refugium present in the Balkans, as the aurochs-like haplotype is seen in both Britain and Hungary and exhibits a star-burst pattern indicative of a post-glacial expansion, but was not sampled as part of the Near Eastern domestication process as it is absent in modern cattle (Troy *et al.* 2001).

Chapter 16

SKELETOCHRONOLOGICAL EVIDENCE FOR SEASONAL CULLING OF CAPRINES

Anne Pike-Tay

Introduction

Reconstruction of settlement patterns and settlement systems of the Körös culture (c. 6000–5500 cal BC) requires assessment of the scale of animal husbandry and the degree to which the human occupants of the Great Hungarian Plain depended upon it. With the appearance of the Neolithic comes the zooarchaeological challenge of finding where an economy lies along the continuum of: 1. small-scale, intensive, mixed farming with stock keeping as the activity of a household or an individual rather than the whole community (Bar-Yosef and Khazanov 1992; Halstead 1996); to 2. a central emphasis on livestock by whole communities, where higher seasonal extremes necessitated higher mobility (e.g. Jarman *et al.* 1982); and ultimately to 3. the exploitation of livestock for their secondary products (wool, milk, traction) for community use and for exchange (Sherratt 1981).

In the case of Ecsegfalva 23, caprines dominate the large mammal sample. Sheep/goats form c. 95% of the total large mammal NISP, the remainder comprised of small numbers of pig, dog, and cattle, demonstrating that hunting of wild game was not an important part of this Early Neolithic economy (Bartosiewicz, chapter 14). On the other hand, László Bartosiewicz's analysis shows fishing to have been at least seasonally important as evidenced by the large numbers of very young pike (*Esox*), most readily available during the April through June period known as 'green flood' (Bartosiewicz, chapter 20). In addition, Erika Gál (chapter 19) finds that nearly half of the small numbers of birds at the site (c. 2% total NISP) represent 'summer visitors', while the rest fall out among a range of resident and over-wintering species, and Pál Sümegi (this volume) provides preliminary evidence for spring and autumn shellfish collecting. Therefore, a key question in reconstructing subsistence strategies and land use by the occupants of Ecsegfalva 23 is whether the site was occupied on a permanent basis or seasonally. In order to shed light on the questions of seasonal mobility and nature of animal husbandry at Ecsegfalva this study assesses season-of-death and age-at-death of the dominant component of the faunal assemblage by way of skeletochronological (growth-increment) studies of sheep/goat dentition.

Methods: seasonality and skeletochronological studies

Skeletochronological or growth-increment studies of archaeofaunas have been increasingly used to investigate seasonal site use and human mobility. Recent applications of such research to *Rangifer, Cervus, Equus, Capreolus, Gazella, Bos* and *Macropus* (especially Bennett's wallaby) – major prey species from Middle, Upper, and Epipalaeolithic sites – have been successful in determining variability in hunter-gatherer subsistence, season of site occupation and degree of mobility in Western Eurasia and Tasmania (e.g. Pike-Tay 1991a; 1993; 2000; Burke 1993; 1995; Lieberman 1993a; Pike-Tay and Bricker 1993; Stutz *et al.* 1995; Burke and Pike-Tay 1997; Stutz

1997; Miracle and O'Brien 1998; Pike-Tay *et al.* 1999; Pike-Tay and Cosgrove 2002; Burke, Pike-Tay and Conard in press). Skeletochronological research can also make significant contributions to the archaeology of Neolithic societies involved in animal husbandry. Seasonality is an integral part of decision making regarding both the timing of the slaughter as well as the response to seasonal variation in the availability of food for stock. Along with mortality data, seasonal data is necessary to the interpretation of culling strategies and productivity of stock (see e.g. Sherratt 1981; Halstead 1998). The various solutions to seasonal fluctuations in the availability of graze, including movement of herds to pasture (e.g. lowland in winter, upland in summer), or foddering and often sheltering animals in winter will result in different settlement patterns and will affect the overall productivity of the local environment in different ways. Skeletochronology provides information regarding both seasonality and faunal mortality patterns, which, when viewed in conjunction with other seasonal, taphonomic, technological, and environmental indicators, can shed light on the ancient decision making behind assemblage formation processes.

Before proceeding to the skeletochronological study of the sheep/goat sample from Ecsegfalva the commonly used methods in seasonality research are briefly reviewed below. More detailed reviews of particular applications can be found in Monks (1981); Pike-Tay (1991a); and Pike-Tay and Cosgrove (2002).

Inferring seasonality by indirect means

Season of site occupation has often been inferred from a wide range of cultural and environmental evidence. Reconstructions of demography and settlement patterns; site topographic location; functional analyses of tool kits; analyses of soil chemistry, matrix granulometry and coprolites; and historical and ethnographic analogy have all provided 'indirect' seasonal indications (cf. Monks 1981). These seasonal inferences are most useful in initial generation of hypotheses, with later testing by means of 'direct' methods (Pike-Tay 1991a).

Direct means of assessing seasonality

'Direct' methods of estimating seasonality rely on the presence, state and composition of seasonally indicative organic remains (Monks 1981). These methods/techniques can be loosely grouped into the following four categories (cf. Monks 1981; Pike-Tay 1991a; Pike-Tay and Cosgrove 2002):

1. Presence-absence of fauna (including insect) and floral remains

Noting the presence or absence of seasonally available faunal and floral remains is the oldest and still most widely-used approach for inferring seasonality at archaeological sites. Effective use of this method requires familiarity with the ethology and biological needs of the relevant species. Whether or not the routes of migrating species or the geographic range of a resident taxon have shifted since the time the site was occupied; if an animal hibernated in difficult- or easy-to-access places in winter; whether or not the fauna or flora being considered was tolerant of grassland/forest, wet/dry, cold/hot conditions, in *past* climatic regimes, are all variables that need to be addressed. Proper use of this method also requires consideration of possible cultural explanations for presence or absence of a species, such as differential transport of anatomical parts, modes of butchering, storage, and culinary practices.

Insect remains recovered from human or faunal remains hold high potential for precise seasonal information of death. As wet screening and flotation are now being routinely used on excavations new seasonal data from insect remains and many other categories of microfauna may be expected. For example, on the basis of age profiles of micromammals deposited in Upper Palaeolithic sites in Cantabrian Spain by raptors such as barn owls, Pokines (2000) has isolated seasons *opposite* to those of human occupancy. Also, the presence of *avian medullary bone,* which forms in the marrow cavities, especially of the tibiotarsus, ulna and femur of female birds of many species where it serves as a source of minerals for eggshell production, provides a clear indicator of spring seasonality (Rick 1975; Driver 1982). Of course it is necessary to establish whether the birds being considered were the prey of human inhabitants or of raptorial birds that share or alternate site occupancy with them (cf. Mourer-Chauvire 1983; Pokines 2000).

As noted above seasonal information may potentially be gleaned from a range of floral remains including the presence of seasonally available macro-botanical species and of pollen, as well as from the analysis of the incremental structure of wood. Wood holds potential seasonal information in the variation apparent in its yearly growth rates. Although dendrochronology is frequently used to age archaeological features the ability of wood to provide ancillary seasonal evidence is under-exploited to date. In regard to the potential of palynology to contribute information useful to seasonality studies, several problems exist at present as a result of: 1. differential preservation of various pollen species (e.g. the inflated representation of pine in many periods within the SW European Palaeolithic); 2. changes in wind patterns, which produce variable rates of deposition; and 3. temporal conflation and the re-deposition of pollen. Thus, the association of pollen with human use of specific floral resources *on a seasonal scale* remains a challenge at the present time.

2. Population structure/ harvest profiles

The population structure method relies upon the seasonal variation in the age and sex composition of hunter-gatherer prey species and of domestic stock. In addition to seasonal inferences, hunting strategies and culling/domestic herd management practices have long been inferred from population structure data. Interpretative frameworks have been offered by researchers such as Spinage (1967); Payne (1973; 1987); Klein (1982; 1987; 1989); Davis (1983); Koike and Ohtaishi (1985; 1987); Lyman (1987); Stiner (1990); Greenfield (1991); Halstead (1998); contributions to Stiner (1991); Lubinski (1997; 2000); Weinstock (2000) and Lubinski and O'Brien (2001). This work has entailed the comparison of the archaeofaunal age profiles to theoretical 'catastrophic', 'attritional', 'prime-age dominated' and 'hunting pressure' patterns for the investigation of scavenger-hunter-gatherer studies; as well as to variations on Payne's (1973) 'milk', 'meat' and 'wool' patterns for the study of animal husbandry. Another level of complexity and of precision in terms of seasonal inference from mortality profiles is added when the sex of the variously aged animals can be established (see e.g. Payne 1973; Weinstock 2000).

Culinary practices, differential preservation (e.g. loss of immature and foetal bones) and differential transport and processing according to skeletal size or anatomical part, are but a few of the many taphonomic and cultural variables that can affect the population structure of an archaeofaunal assemblage. In addition, the range of temporal variation in occurrence of some of the physiological and attritional markers of ageing such as epiphyseal closure, dental eruption and attrition, and crown height wear, is often too wide for a seasonal determination. Tooth eruption data from the younger animals provide the most reliable seasonal data as eruption schedules are fairly standardised, while tooth wear does not occur at an even pace, and the age at which ossification occurs varies among the skeletal elements. Therefore, seasonality determinations based on population structure alone are not always reliable or comprehensive.

3. Stable isotope analysis

Nitrogen and carbon isotopic composition of human bone collagen has provided direct evidence for shifts in human diet through time (e.g. Lubell *et al.* 1994) as well as indirect evidence for site seasonality. Zilhão (2000, 161) has used this evidence to demonstrate that contemporaneous Portuguese Mesolithic sites in the massifs of Estremadura and shell-midden sites in the Tagus estuary 'represent separate adaptive systems, not different functional or seasonal poses of a single, highly diversified system…'. Analysis of nitrogen and carbon isotopes has also been used to indirectly and directly assess seasonal dietary shifts in a range of species from sheep to birds to reindeer (e.g. Ambrose and Noor 1993; Hobson *et al.* 1993; Drucker *et al.* 2001; Drucker *et al.* in press; see Pike-Tay and Cosgrove 2002 for more detailed review). Oxygen isotope analysis, stemming from the temperature-related intake of ^{18}O in marine shells, however, has the longest history of employment in seasonality investigations (Shackleton 1973; Killingley 1981; Bailey *et al.* 1983). Nonetheless, work by Barrera and Tevesz (1990, 566) shows that substantial within-shell oxygen and carbon isotopic variability exists for at least some genera of bivalves and brachiopods, leading them to conclude that 'caution should be used in inferring paleotemperature/paleosalinity values from fossils when their Recent counterparts have not been thoroughly characterized isotopically'. Similarly, Andrus and Crowe's (2000) geochemical analysis of *Crassostrea virginica* (American oyster) shows absolute values of ^{13}C and ^{18}O as well as incremental growth band formation varied between individuals of the same bed, leading the researchers to conclude that isotopic and visual analyses should be performed only on large populations of these bivalves. Marine molluscs manifest environmental changes in a variety of ways ranging from alterations in chemical composition and microstructure as well as differential incremental growth rates, the final category of seasonality evidence to be discussed here.

4. Cyclical, developmental and stress-related physiological events

This category of seasonal evidence includes cyclical growth marks, antler growth, stress indicators and the results of dental microwear analysis. Developmental events are frequently recorded on bony tissues and are often annually, seasonally, and diurnally synchronised. These developmental marks are found in the incremental growth structures of a wide range of mammals, reptiles, birds, fish and mollusks. The study of incremental growth structures (skeletochronology) in dentition will be discussed separately below.

The growth and shedding of antlers. These normally coincides with a fairly broad seasonal schedule for high latitude and temperate zone members of the family *Cervidae* (see Pike-Tay and Cosgrove 2002 for review of studies using antlers as seasonal evidence). Nevertheless as the regularity of this schedule varies with the sex, age, and health of the individual animal and according to latitude, and cast antler is often collected from the landscape for use as raw material, antlers are best used as ancillary seasonal evidence.

Stress indicators. These have until recently been generally neglected as potential sources of seasonal information. These indicators include 1. seasonal osteoporosis, which was first recognized as a potential seasonal indicator in spring-killed caribou by Binford and Bertram (1977); 2. 'Harris lines' that occur on mammalian long bones, and 3. dental enamel hypoplasias. The latter two markers indicate recovery from stress episodes. Important recent work by Dobney and Ervynck (1998) on hypoplasias in archaeological pigs' teeth and by Niven (2000) on enamel hypoplasias in North American Plains bison, demonstrates the relationship between seasonality and dental enamel defects found on these human subsistence species.

Dental microwear analysis. This can contribute valuable seasonal information. This is demonstrated by Ingrid Mainland's reconstruction of seasonal management strategies of caprines in Norse Greenland (1998a; 2000a) and at Ecsegfalva 23 (chapter 17). In addition, Ward and Mainland (1999) have established a modern control sample of stall-fed vs. free-range/rooting pigs for extension of dental microwear analyses to archaeological *Sus*.

Skeletochronology or incremental growth structure analysis. This was first defined by Monks (1981, 193) as follows:

> Incremental structures are distinctive, self-contained additions to the previous growth of an organism. These structures result from varying rates of growth, the most recent growth increment resting on its immediate predecessor. Changes in the rate of growth are influenced primarily by seasonal growth cycles, thus knowledge of the factors that influence these growth cycles, such as spawning periods, migration, nutrition, and temperature, plus observations on the point in the cycle at which growth was terminated provides information on which seasonality inferences can be based.

As noted above, incremental growth structures occur in molluscs, fish, reptiles, and marine and terrestrial mammals. These have been analysed by biologists and some zooarchaeologists for information regarding environment, seasonality and/or mortality profiles. The evolution and processes of skeletal biomineralisation responsible for these incremental structures across a wide range of taxa have been reviewed (for the mechanisms of shell formation and gastropod shell structure, see Bandel 1990a; 1990b; Claasen 1998; for the microstructure of the Bivalvia, see Carter 1990; and for the microstructure and mineralisation of vertebrate skeletal tissues including dental structures, see Francillon-Vieillot *et al.* 1990; Carlson 1990; Lieberman 1993b; Klevezal 1996). An in-depth literature review and critical comparison of methods for assessing seasonality in shells from archaeological sites, including isotopic and incremental-growth structure analysis, are provided by Claasen (1993; 1998). Research by Galina Klevezal and colleagues (especially Klevezal and Kleinenberg [1967] 1969) constitutes the longstanding major scientific reference for investigations into the incremental structures of mammalian bone and teeth, and includes summaries of data on the presence of annual/cyclical layers in the bone or tooth tissues of mammalian species at the time of publication (see also Klevezal 1980; 1996).

'Adhesion lines', the most common incremental structures in bone, form during winter in many high latitude and temperate zone mammals and are often most visible in the mandible (cf. Klevezal and Mina 1973; Klevezal *et al.* 1985; Francillion-Viellet *et al.* 1990). However, the potential of the incremental structures of bone (as opposed to those of teeth) for the archaeological assessment of age or season of death has not yet been fully explored. The success of Klevezal *et al.* (1985) in differentiating seasonal generations of field voles (*Microtus agrestis*), and of similar observations of mandibular bone adhesion lines on recent and archaeological mandibles of Bennett's wallaby (*Macropus rufogriseus*) (Pike-Tay and Cosgrove 2002), demonstrates the potential of this category of bone growth for seasonal estimates. Similarly, Stallibrass (1982, 112) has suggested that analysis of periosteal layering in long bones may prove more exacting and useful to zooarchaeologists than ageing by epiphyseal fusion, although this remains to be evaluated.

Skeletochronology of mammalian teeth. As the assessment of season of capture and age at death from the recording structures of mammalian teeth is the method employed in the present study of the Ecsegfalva 23 caprines, it will be given more in-depth review than the above methods and applications.

A yearly cycle is marked in the mineralised tissues of the teeth of most high latitude and temperate zone mammals by one wide (growth) *zone*, temporally corresponding to the warmer seasons; in addition to one narrow *annulus* (slow growth) and/or a 'line of arrested growth'

(LAG), temporally corresponding to 'winter', and observable in the dental cementum and/or dentine (cf. Mina and Klevezal 1970; Castanet 1981; Francillon-Vieillot *et al.* 1990; Lieberman 1993a; 1993b; Pike-Tay 1995; Klevezal 1996; Pike-Tay and Cosgrove 2002). Therefore, wildlife biologists have long used counts of these annular increments to age individual animals (e.g. Laws 1952; Klevezal and Kleinenberg [1967] 1969; Morris 1972; Spinage 1973; Grue and Jensen 1979; Klevezal 1996).

The optical and physical expressions of the growth increments in teeth result from differing patterns of collagen fibre organisation and of cell content and mineralisation (Castanet 1981; Francillon-Vieillot *et al.* 1990; Lieberman 1993a; 1993b; Klevezal 1996). Lieberman (1993a; 1993b) observed that differentiation of growth layers in dental cementum results from seasonal rhythms of cementoblast activity as well as from occlusal strain. Controlled experiments with goats point to at least two major causal factors in the formation of dental cementum increments: 1. nutritional quality of diet, which accounts for the width of the growth band; and 2. food hardness, which affects occlusal strain, resulting in fibrillar angle changes in the extrinsic and intrinsic collagen fibres (responsible for the different optical qualities of the *growth zone* and *annulus* under the microscope) (Lieberman 1993a; 1993b). Pike-Tay's (1995) and Weinand's (1997) studies of well-documented *Rangifer* and *Odocoileus* herds, whose forage quality and coarseness varied seasonally, respectively support Lieberman's conclusions. However, the contributions of endogenous factors triggered by photo-periodicity or seasonal changes in basal metabolic rates cannot be ruled out (Pike-Tay 1991a; 1991b). As these microstructural variations in teeth result from seasonal differences in the forage characteristics of herbivore diets, skeletochronology provides zooarchaeology with a valuable tool in the reconstruction of site seasonality and prehistoric subsistence strategies.

Skeletochronology of the Ecsegfalva caprine sample

Materials and methods

Of the 18 hemi-mandibles sampled for skeletochronological analysis, at least one individual tooth from 17 of them (1 goat, 1 possible goat, 15 sheep) provided results *(Table 16.1, Figs 16.1–2).* This same representative sample is also the subject of microwear analysis by Mainland (chapter 17) and the complementary nature of the results of both studies is discussed in her contribution. The condition of the teeth made the dental increment analysis particularly challenging as ancient fungal intrusions permeated the sample; something that often occurs in samples buried in very wet conditions. The techniques for dental growth mark analysis of the Ecsegfalva caprine teeth follow the protocol described in Pike-Tay (1995), including: 1. the preparation and use of radial 'dry' thin sections (c. 30µ) taken at the mesial-distal midline of the tooth; 2. measuring the areas of acellular cementum where the apposition of growth increments is most regular (which is near the root/enamel junction on the teeth of cervids, large bovids and caprines, but which differs in location on some carnivore and macropod teeth: Pike-Tay and Cosgrove 2002); and 3. the use of computerised image analysis of digitised scans of slides under polarised transmitted light (magnification 40x, 100x, and 250x) to measure consecutive growth zone widths at 2 or 3 cementum transects per tooth.

Ageing of the individual sheep and goat(s?) by dental annuli counts also followed the protocol outlined in the Pike-Tay (1995) study, where the eruption schedule of each tooth is taken into account. In other words, since first 'winter' annulus forms during the first winter of life with caprines of known age studied to date by the author, in order to assess the correct age in years, the number of annuli counted on the incisors or M1 is a direct measure of age; 1 year is added to

Table 16.1. Dental cementum analysis

Specimens and description	Species	Tooth chosen for analysis	Overall wear	Magnification	Annuli count	Adjusted age*	Cementum growth stage/season of death (F = status of final cementum band)
1628 right mandibular series D3, D4, M1 broken; roots not intake	Sheep	M1	LW	40x	2	nearly 2 years	2 annuli and possible slight growth zone (friable specimen) **F = winter/possibly early spring** *Poor visibility**
3709 right mandibular series D2, D3, D4, M1, M2 lightly brecciated	Sheep	M1	LW-MW	100x	neonatal & 3	nearly 3 yrs	3 annuli & possible growth begins **F = winter/possibly early spring** *Poor visibility**
4706 left mandibular series D4, M1, M2 broken; moderately brecciated	Sheep	M1	LW	100x	3	nearly 3 yrs	F ends in 3rd annulus **F = winter** *Poor visibility**
4714 left mandibular series D2, D3, D4, M1 heavily brecciated	Sheep	frag D3 & D4	– * Frag D3 & D4	40x	neonatal & 3	nearly 3 yrs	F ends in 3rd annulus **F = winter** *Poor visibility**
5038 right mandibular series D2, D3, D4, M1 fragmented; heavily brecciated	Sheep	D4	MW	40x	3	nearly 3 yrs	3 annuli & slight growth begins **F = winter/possibly early spring** *Poor visibility**

**+2 for PM & M3*
**+1 for M2*

Table 16.1. Continued

Specimens and description	Species	Tooth chosen for analysis	Overall wear	Magnification	Annuli count	Adjusted age*	Cementum growth stage/season of death (F = status of final cementum band)
5066							
right maxillary series D2, D3, D4, M1 moderately brecciated	Sheept	M1	LW – MW		*visibility too poor to analyse**		
5100							
right mandibular series D3, D4, M1 lightly brecciated	Goat	M1	LW – MW	40x	3	nearly 3 yrs	F ends in 3rd annulus??? **???** *Extremely poor visibility**
5110							
right mandibular series D3, D4, M1 broken; lightly brecciated	Sheep	M1	LW – MW	100x	neonatal & 3	nearly 3 yrs	F ends in 3rd annulus **F = winter** *Poor visibility**
5119							
left mandibular series D2, D3, D4, M1 heavily brecciated	Sheep/Goat	M1	LW – MW	40x	neonatal & 3	3 yrs	F = neonatal line, 3 annuli, ending in 30% growth **F = spring** *Poor visibility**
5146= 2 individuals ***adult***							
right mandibular series M2, M3 lightly brecciated	Sheep	M2	MW – HW	100x	5 or 6	6 or 7 yrs	5 or 6 annuli, F= completed growth zone; possibly annulus forming **F = end of fall/early winter** *Poor visibility**

**+2 for PM & M3*
**+1 for M2*

Table 16.1. Continued

Specimens and description	Species	Tooth chosen for analysis	Overall wear	Magnification	Annuli count	Adjusted age*	Cementum growth stage/season of death (F = status of final cementum band)
juvenile							
right mandibular series D2, D3, D4, M1 moderately brecciated	Sheep	M1	LW	40x	2	nearly 2 yrs	2 annuli + growth zone beginning **F = early spring** *Very poor visibility**
5770							
left mandibular series D3, D4, M1, M2 fragmented; moderately brecciated	Sheep	M1	LW	100x	2	2 yrs	2 annuli + 35% growth **F = spring/late spring** *Poor visibility**
6706							
right mandibular series D2, D3, D4, M1 moderately brecciated	Sheep	M1	LW	40x	neonatal +3	nearly 3 yrs	F = neonatal line +3 annuli, ending at end of 3rd annulus **F = late winter** *Poor visibility**
6747							
right mandibular series D3, D4, M1(erupting) lightly brecciated;	Goat	D4	LW – MW	100x	neonatal + 1	ca. 6 months	F = neonatal line +1 annuli, F in or at end of 1st annulus **F = winter/late winter** *Poor visibility**
7282							
left mandibular series D2, D3, D4, M1 broken; lightly brecciated	Sheep (?) **probably goat*	D4	MW	40x	neonatal + 2	ca. 18 mo.	F = neonatal line +2 annuli, F in annulus **F = winter** *Poor visibility**

**+2 for PM & M3*
**+1 for M2*

Table 16.1. Continued

Specimens and description	Species	Tooth chosen for analysis	Overall wear	Magnification	Annuli count	Adjusted age*	Cementum growth stage/season of death (F = status of final cementum band)
8674 right mandibular series D2, D3, D4, M1 moderately brecciated	Sheep	M1	LW	100x	neonatal + 2	ca. 2 yrs	F = neonatal + 2 annuli; possibly new growth zone beginning **F = winter/late winter/spring** *Very poor visibility**
8971 left mandibular series D2, D3, D4, M1 moderately brecciated	Sheep	D4	LW – MW	40X	neonatal + 2	ca. 18 mo.	F = neonatal line +2 annuli, F in annulus **F = winter** *Poor visibility**
10292 left mandibular series D2, D3, D4 fragmented	Sheep	D4	LW – MW		neonatal + 1, possibly 2	ca. 18 mo.?	F = neonatal line + 1 or 2 annuli, F at completed growth zone or in 2nd annulus **F = late fall/winter** *Very poor visibility**

**+2 for PM & M3*
**+1 for M2*

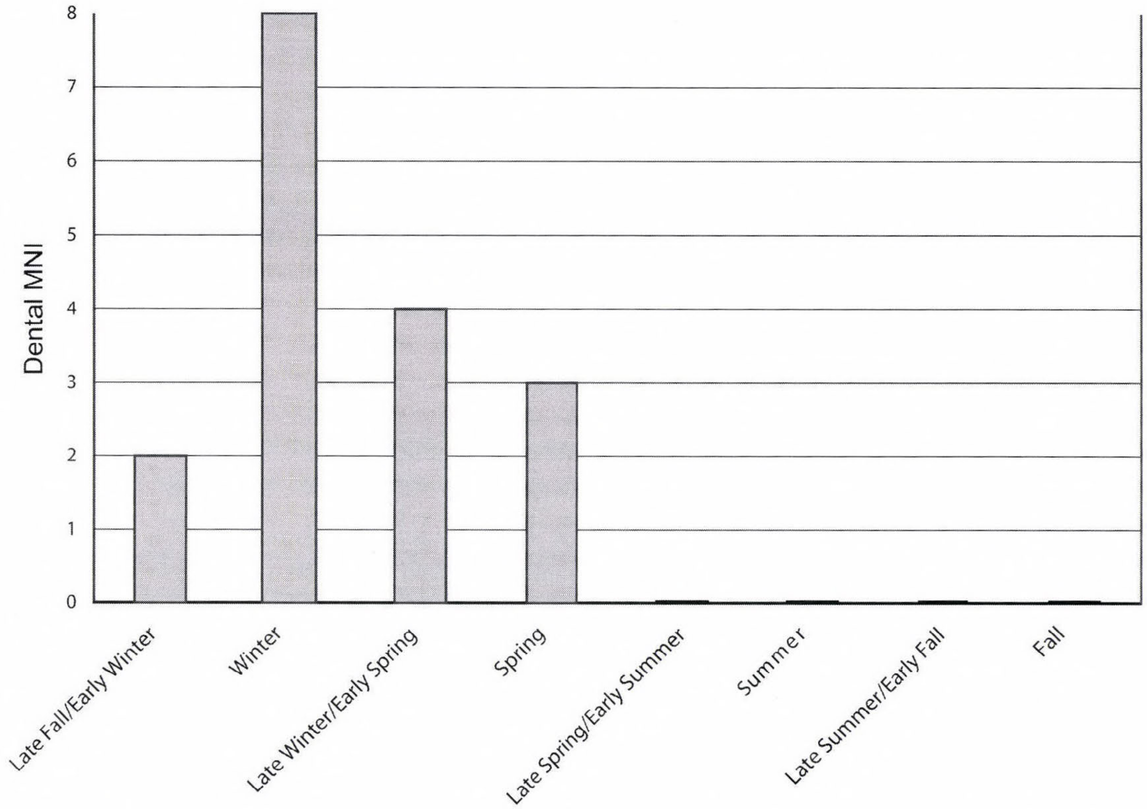

Fig. 16.1. Season of death distribution based on skeletochronology of sheep/goat sample from Ecsegfalva 23

M2; and 2 years are added to P2, P3, P4 and M3 (cf. Mitchell 1963; Miller 1974; Grue and Jensen 1979; Pike-Tay 1991a; 1991b).

Results

The skeletochronological evidence for season of death and age at death of the Ecsegfalva sheep and goat is presented in *Figs 16.1–2.* The majority of sheep were culled primarily in winter into early spring of their second or third year of life. In addition, two individuals were slaughtered in late autumn or early winter and two sometime during the spring. One of the two unambiguously identified goats was killed during its first winter; while season of death of the second, a three year old, could not be assessed. There was only one prime-aged adult in the sample: a sheep that died in late fall or early winter.

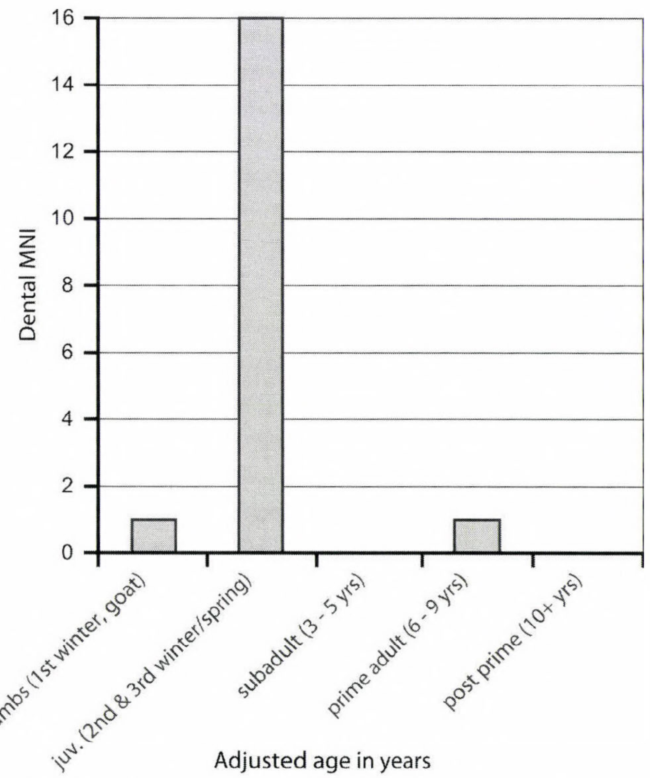

Fig. 16.2. Ages of caprines captured by skeletochronology

Discussion and conclusions

The harvest profile and seasonal information gained from the skeletochronological analysis of the caprines from Ecsegfalva suggest several economic possibilities. First, the dominance of second and third year old sheep is consistent with a strategy of raising caprines for 'meat' (Payne 1973), rather than for milk or wool: products which do not seem to take on much importance until much later in the Neolithic of the Great Hungarian Plain. Secondly, impact on available pasture would be minimised and maximum returns gained in the slaughtering of these juveniles and young sub-adults, which would have peaked in terms of their body weight. Thirdly, as results show a predominance of slaughter from winter through to early spring, if the residents of Ecsegfalva participated in small-scale (household level?), intensive, mixed farming (see also the contributions of Willis (chapter 6), and Bogaard *et al.* (chapter 23) along with stock keeping, then sheep and the smaller number of goats either remained in the vicinity of the site or were taken elsewhere for summer pasture. The stressed condition of the sheep's health as suggested by their small size (Bartosiewicz, chapter 14) and the condition of their teeth (noted above) could be the result of overgrazing due to penning or restricted availability of pasture (cf. Mainland, chapter 17). Certainly, the annually occurring 'green flood' period from April through June would probably have circumscribed and reduced areas of pasture local to the site, which like most of the region, is situated on a flood plain. Indeed, this may have generated impetus for the winter/early spring slaughter of juvenile sheep and goats, culling the size of the flocks to accommodate the coming reduction in locally available pasture. Although the sample analysed here does not provide evidence for summer slaughter, other seasonal evidence such as the presence of young pike, shellfish, and some birds, as well as evidence for intensive weeding of arable land (Bartosiewicz; Sümegi; Gál; Bogaard, Bending and Jones, this volume) suggests a human presence from spring through autumn. The possibility exists that certain individuals were responsible for taking the flocks unknown but potentially considerable distances for summer pasture, as such transhumance has been noted in the historic period (László Bartosiewicz, *pers. comm.*). The remainder, perhaps the majority of the community, may have stayed on site tending gardens and collecting a range of foods. What is certain is that the days of relying upon sheep (and the occasional goat) as the primary subsistence item along the Kiritó were numbered regardless of the season. As Bökönyi (1974) has noted, and Bartosiewicz discusses in this volume, the wet conditions of the Danube and Carpathian Basins did not in the end suit the imported Middle Eastern caprines of the Early Neolithic, which would soon be replaced by locally domesticated pigs and cattle, thereby ending at least one of the experiments of the Körös culture.

Acknowledgements

I would like to thank Alasdair Whittle for the invitation to work on the Ecsegfalva materials. I am grateful to László Bartosiewicz and Ingrid Mainland for helpful advice and context for the caprine samples. Finally, I extend thanks to Vassar students Sheryl Okamura and Anne Tiballi for their help with specimen preparation.

Chapter 17

A MICROWEAR ANALYSIS OF SELECTED SHEEP AND GOAT MANDIBLES

Ingrid L. Mainland

Introduction

There is an increasing recognition within archaeology of the potential of livestock diet for elucidating human-animal interactions in the (pre)historic past (Charles *et al.* 1998; Thomas and Mainland 2005). The strategies employed by farmers to feed their animals, whether through the use of supplementary fodders such as leafy- or grassy-hay, or the regulation of grazing and foraging, determine the seasonal round of activities associated with animal husbandry (Akeret *et al.* 1999; Mainland 2000a; Akeret and Rentzel 2001; Bentley *et al.* 2003) and affect the productivity and impact on the environment of particular pastoral and arable husbandry systems (Palmer 1998; Forbes 2000; Mainland 2000a). Moreover, the elaboration and maintenance of grazing rights and the movements of animals and their herders across the landscape will facilitate social negotiation within and between communities (Halstead 2000), while inequalities in access to fodder can provide the impetus for socio-economic differentiation (McGovern *et al.* 1988; Bogucki 1993).

Within the context of Neolithic studies, analyses of livestock diet are arguably an important element in furthering current debate regarding the mobility of Neolithic herders and the degree of integration between livestock and arable farming (Whittle 1996; Halstead 2000; Thomas 2003; Bogaard *et al.* in press). Bentley *et al.* 2003, for example, use isotopic signatures from food and water ingested by grazing/browsing animals to identify and trace herd mobility in the LBK settlements of central Europe while Akeret *et al.* (1999) and Charles and Bogaard (2005) illustrate how the grazing of specific vegetation communities and habitats within the wider landscape in early farming communities in Switzerland and Turkmenistan, respectively, can be identified through the analyses of plant remains consumed by livestock. In this contribution to the Ecsegfalva project, a further palaeodietary technique, dental microwear analysis, is employed to provide insight into sheep/goat diet at Ecsegfalva and in doing so aims to shed some light on the relationship between arable and pastoral farming and the seasonal mobility of sheep/goat herds within the Körös culture of the Great Hungarian Plain.

Dental microwear analysis, the examination of microscopic tooth wear patterns, is a well established palaeodietary technique which has only recently been applied to livestock diet within archaeological contexts (Beuls *et al.* 2000; Mainland 2000a; Mainland and Halstead 2005). In common with trace element and isotopic studies, microwear analysis allows insight into diet at a functional/compositional level (e.g. hard vs. soft; abrasive vs. non-abrasive, frugivore vs. folivore, etc.) rather than the identification of specific foodstuffs consumed (Rose and Ungar 1998; Thomas and Mainland 2005). Research on modern ovicaprines has demonstrated that for these species analyses of microwear patterning can potentially be used to assess intensity of grazing pressure, whether animals are grazing/browsing or stall-fed and the use of 'soft-textured' or bulky fodders, like leafy-hay, milled cereals and seaweed (Mainland 1998a; 2000a; 2000b; 2003a; 2003b).

Materials and methods

Samples analysed: species, context of deposition and season-of-death

A total of 17 sheep/goat mandibles and 1 maxilla were selected from the Ecsegfalva faunal assemblages for microwear and cementum annuli analysis *(Table 17.1)*. Selection focused on mandibles with more-or-less intact molar rows to facilitate cementum and microwear analysis (László Bartosiewicz, *pers. comm.*). This has biased the sample towards juveniles, as adult ovicaprines were only represented by fragmentary mandibles and loose teeth (see e.g. Bartosiewicz, chapter 14). Payne (1985) was used to identify species criteria for the juvenile ovicaprine dentition, giving 12 sheep, 3 goats and 1 mandible for which identification was not possible *(Table 17.1)*. The adult mandible and maxilla were not identified to species. Three teeth were excluded from the microwear study due to the presence of damaged enamel surfaces: small find nos. 4706 (sheep), 5146 (the juvenile sheep) and 6747 (goat) *(Table 17.1)*. Small find nos. 5146 (the adult sheep/goat) and 5066 (sheep) were excluded due to the absence (on account of the specimens' age) of the deciduous fourth premolar (dP4), the preferred tooth for dental microwear analysis in ovicaprines (Mainland 1998a). Of the 13 specimens retained for microwear analysis, one mandible (small find no. 1628) was recovered from a Trench 23A 'scoop' or shallow pit deposit; the remaining derive from Trench 23B and are associated with the occupation layer (n = 8) and the upper (n = 5) and middle (n = 1) fills of pit 390. Pike-Tay's (chapter 16) analysis of cementum annuli indicates that most of the examined individuals were aged between 2 and 3 years old at death and that they were culled during winter or spring *(Table 17.1)*.

Recording and analysing microwear patterns

The methodologies employed for the Ecsegfalva samples follow those used in previous microwear studies (Mainland 2000a; 2000b; 2003a; 2003b; Mainland and Halstead 2005). Analysis was based on scanning electron microscope (SEM) images taken at 500x from a specific area of enamel in the anterior enamel band of the bucco-posterior cusp in the dP4. Microwear defects were counted and measured using Microwear 2.2 (Ungar 1995) and were categorised into six feature types using the ratio of feature length (L) to feature breadth (B): pits = L:B ≤ 4:1; striations = L:B > 4:1; rounded pits = L:B ≤ 2:1; ovoid pits = L:B > 2:1 ≤ 4:1; broad striations = L:B > 4:1 ≤ 10:1; narrow striations = L:B > 10:1 (Solounias and Hayek 1993; Mainland 2000a; 2000b; 2003a; 2003b). The following variables were then calculated for each individual tooth: total number of defects; relative frequency of pits (expressed as a percentage of all features); the ratio of rounded to ovoid pits (expressed as a percentage of pits); the ratio of narrow to broad striations (expressed as a percentage of striations); average length of rounded pits, ovoid pits, narrow striations and broad striations; average breadth of rounded pits, ovoid pits, narrow striations and broad striations; average orientation of pit and striation long axis.

To interpret diet, the Ecsegfalva mandibles were compared with a large sample of modern known diet mandibles using stepwise discriminant analysis (DA) (Mainland 2003a; 2003b; Mainland and Halstead 2005) *(Table 17.1)*. Discriminant analysis can be used to classify samples of unknown origin (here, the Ecsegfalva mandibles) into known groups (here, the modern known-diet ovicaprine mandibles) on the basis of predictor variables (here, microwear variables) (Tabachnick and Fidell 1996). Output includes a classification table listing likely group membership and a scatterplot illustrating the position of individual cases (for samples of known and unknown origin) on the discriminant functions derived *(Table 17.1; Figs 17.2–4)*; the plot allows insight into how similar are the cases with regards combined values for the predictor variables

Table 17.1. The sheep/goat mandibles from Ecsegfalva considered for microwear analysis: lists for each mandible, small find number, context of deposition, species, season-of-death (after Pike-Tay, chapter 16), age (after Pike-Tay, chapter 16) and the diet group predicted by stepwise discriminant analysis (DA = discriminant analysis; hg = high abrasive grazer; lab = low abrasive grazer; l/c = leafy-hay/milled cereal)

Small find no.	Species	Context-of-deposition	Season-of-slaughter	Age	Examined for microwear?	Classification in DA
1628	Sheep	basal scoop, 23a	winter/ early spring	c. 2 yrs	yes	hg
3709	Sheep	Occupation layers	winter/ early spring	c. 3 yrs	yes	hg
4706	Sheep		winter	c. 3 yrs	no	–
4714	Sheep	occupation layers	winter	c. 3 yrs	yes	hg
5038	Sheep	occupation layers	winter/ early spring	c. 3 yrs	yes	hg
5066 (maxilla)	Sheep/goat		unknown	–	no	–
5100	Goat	pit 390 (upper)	unknown	c. 3 yrs	yes	hg
5110	Sheep	pit 390 (upper)	winter	c. 3 yrs	yes	hg
5119	Sheep/goat	pit 390 (upper)	spring	c. 3 yrs	yes	hg
5146	Sheep	pit 390 (upper)	early spring	c. 2 yrs	no	–
5146	Sheep/goat	pit 390 (upper)	fall/early winter	c. 6–7 yrs	no	–
5770	Sheep	pit 390 (upper)	spring/late spring	c. 2 yrs	yes	hg
6706	Sheep	pit 390 (mid)	late winter	c. 3 yrs	yes	hg
6747	Goat	occupation layers	winter/late winter	c. 6 m	no	–
7282	Goat	occupation layers	winter	c. 18 m	yes	lab
8674	Sheep	occupation layers	winter/late winter/ spring	c. 2 yrs	yes	hg
8971	Sheep	occupation layers	winter	c. 18 m	yes	l/c
10292	Sheep	occupation layers	late fall/winter	c. 18 m	yes	hg

(i.e. similarity in microwear patterning) and can readily be used to assess variability according to factors such as species, context of deposition of season-of-slaughter *(Figs 17.2–4).*

The discriminant functions employed in this analysis separate three modern known-diet groups, grazing sheep kept at high stocking levels in which soil ingestion is high, grazing sheep kept at low stocking levels in which soil ingestion is low and stalled sheep/goats fed leafy-hay and milled cereals in which soil ingestion is assumed to have been minimal *(Table 17.1)* (Mainland 2003a; 2003b; Mainland and Halstead 2005). Between group differences reflect the presence of heavily striated enamel surface in sheep ingesting high levels of soil abrasives and pitted enamel surfaces in the low abrasive grazers and stall-fed animals (*Table 17.1; Fig. 17.1,* function 2); stall-

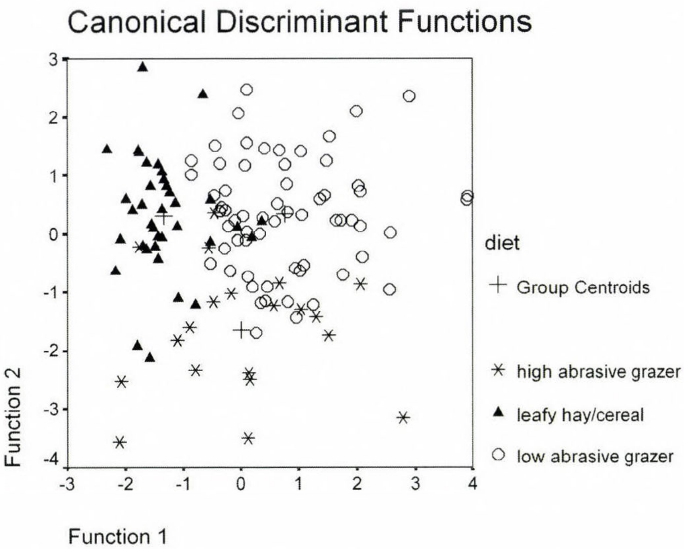

Fig. 17.1. Stepwise discriminant analysis plot for known diet sheep/goat used in the classification of the archaeological mandibles from Ecsegfalva. Function 1 separates fodder-fed from grazing individuals such that feature dimensions (lrp, lns, bns) and pit length orientation (plo) decrease and the absolute frequency of defects (dn) increases towards the LHS of the diagram; function 2 separates the low abrasive grazers and the fodder-fed individuals from the high abrasive grazers, such that the relative frequency of pits and of rounded pits increases towards the top of the diagram. Abbreviations: see text

fed animals have more and smaller microwear features than low abrasive grazers and this difference is attributed to variation in dietary texture and/or abrasive particle size, specifically a softer diet and/or smaller abrasives in leafy-hay and cereal-fed sheep (*Table 17.1; Fig. 17.1,* function 1) (Mainland 2003a; 2003b; Mainland and Halstead 2005).

Results

11 of the Ecsegfalva mandibles are classified within the high abrasive grazing group, one (sheep no. 8971) is classified with leafy-hay/cereal and one (goat no. 7282) with the low abrasive grazers *(Table 17.1).* Consideration of the position of these latter individuals within the discriminant plot indicates that goat no. 7282 falls within the overlap zone between high abrasive and low abrasive grazers and as such could have been classified with either; the outlying position of sheep no. 8971 on the other hand indicates microwear which is clearly very different from the rest of the mandibles examined at Ecsegfalva *(Table 17.1; Fig. 17.1).* There is little evidence for any differences between spring-killed and winter-killed animals, though samples sizes are very small in each case *(Fig. 17.2).* Likewise, no obvious distinction could be found between sheep and goats, though again sample sizes are very small; as noted above, goat no. 7282 does have a slightly atypical pattern, but goat no. 5100 falls securely with the sheep *(Fig. 17.3).* The one mandible from Trench 23A exhibited microwear comparable with the rest of the assemblage and there did not appear to be any variation in microwear between individuals deposited in the occupation layers and pit 390 *(Fig. 17.4).*

Discussion

Analyses of microwear patterns in modern known-diet ovicaprines has suggested that inter-population variation in these species can be attributed to two primary factors: the amount of soil abrasives ingested during grazing or by stalled animals and the tensile force required to comminute 'soft' or bulky fodders such as leafy-hay, milled cereals and seaweed (Mainland 2000a; 2000b; 2003a; 2003b). Levels of soil ingestion reflect management practices and tend to be lower in stall-fed animals and in those kept at low stocking levels; high levels of soil ingestion are associated with high stocking densities, as is found in penned/corralled animals or with overstocking on cultivated and other grasslands with a sparse and easily disturbed vegetation cover susceptible to erosion (Healy and Ludwig 1965; Ludwig *et al.* 1966).

The classification of nearly all the Ecsegfalva sheep/goat into the high abrasive grazing group suggests that these individuals were ingesting quantities of abrasives, and so on current understanding of microwear formation in ovicaprines were pastured at high stocking levels consistent with overgrazing and/or penned/corralled animals (Mainland 2003b) *(Table 17.1)*. It seems that there was little variation in husbandry methods between winter and spring, or between sheep and goat, though sample sizes really are too small to assess variation in diet by species with any confidence *(Figs 17.2–4)*. Likewise, diet does not appear to vary with context-of-deposition *(Fig. 17.4)*. The outlier, no. 8971, indicates a sheep which had an atypical diet in comparison with the rest of herd, and in terms of microwear may reflect an animal for which ingestion of soil was minimal because of a good level of vegetation cover, because it was stalled and/or because it was fed on a diet of 'soft' textured foods with few abrasives (Mainland 2003a; 2003b). This could indicate an individual animal selected for supplementary feeding because of its use for milking and/or breeding, or an animal selected to be fattened-up for slaughter (an interpretation consistent with the fact that dental microwear reflects diet during the last few weeks of slaughter (see e.g. Mainland and Halstead in 2005). In the latter case, selection might reflect either the importance of the eventual consumption event or the chance availability of surplus grain that was fed to livestock to avoid wastage (Flannery 1969; Halstead 1990). However, as individuals with atypical microwear patterns are occasionally seen within modern known diet grazing and fodder-fed populations for no apparent 'functional' reason (see e.g. *Table 17.1; Fig. 17.1*), sheep no. 8971 may simply reflect the fact that some individuals are better at foraging for high quality vegetation than others, even where vegetation cover is limited in extent (see e.g. Hunter and Milner 1963; Milner and Gwynne 1974).

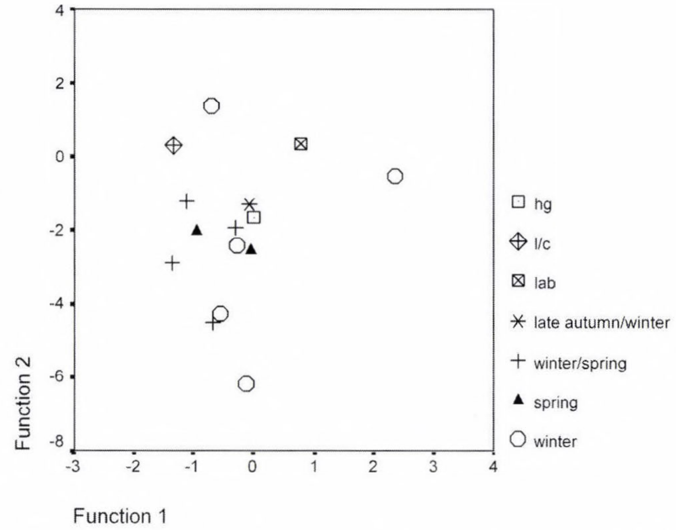

Fig. 17.2. Classification of the Ecsegfalva sheep/goat mandibles using the stepwise discriminant analysis model detailed in Fig. *17.1* shows the position of group centroids (i.e. the mean scores for each group on functions 1 and 2) for the known diet groups and of each individual case (i.e. animal) for the archaeological material. Under this model, feature dimensions (lrp, lns, bns) and pit length orientation (plo) decrease and the absolute frequency of defects (dn) increases towards the LHS of the diagram while the relative frequency of pits and of rounded pits increases towards the top of the diagram. Abbreviations: see text. Here archaeological material is coded by season-of-slaughter

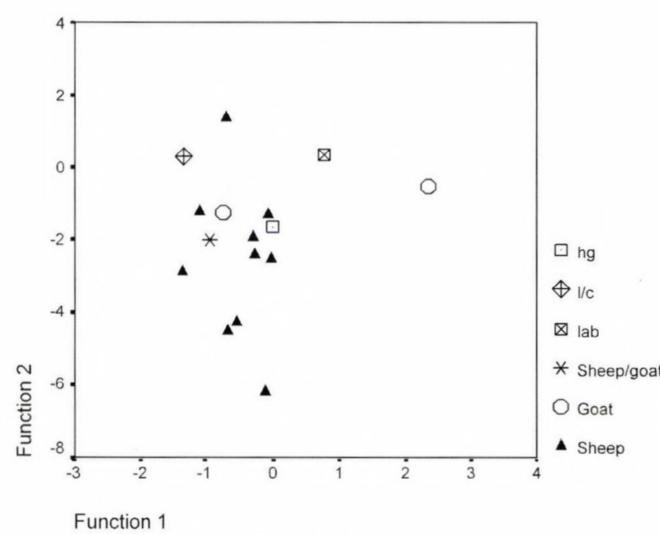

Fig. 17.3. As *Fig. 17.2.* Here archaeological material is coded by species

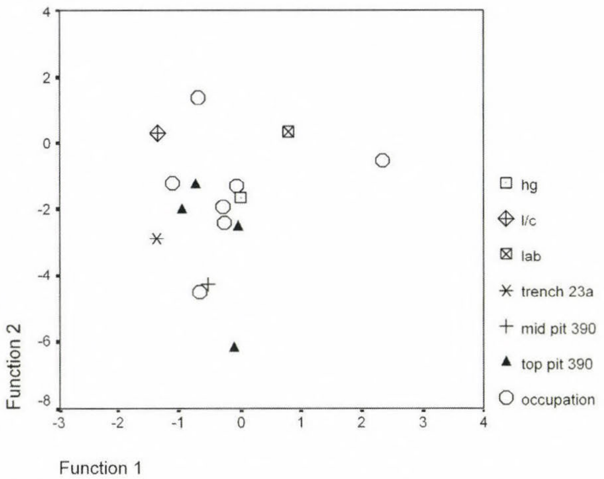

Fig. 17.4. As *Fig. 17.2.* Here archaeological material is coded by context-of-deposition

Conclusions

Microwear patterns imply that during winter and spring, sheep, and probably goats, at Ecsegfalva were kept under high stocking levels, perhaps in fairly confined conditions, and were not provided with permanent winter housing nor solely fed on supplementary fodders such as leafy-hay or milled cereals. A restricted, intensive herding of sheep on arable fields and field margins within the immediate locality of settlements has been suggested for the Early Neolithic in Greece (Halstead 1996; 2000) where it is argued that sheep were closely integrated with arable cultivation and were vital for maintaining fertility and crop yields by providing dung and keeping down weeds. Halstead's (2000) model of sheep intensively grazing within small enclosed fields/plots after harvest and on field edges and other patches of vegetation around the settlement during the growing season is consistent not only with the high levels of soil ingestion observed in the Ecsegfalva mandibles but also with Bogaard *et al.*'s (chapter 23; in press) and Willis's (chapter 6) reconstruction of cereal husbandry and the local palaeoenvironment, respectively. These authors indicate well-manured autumn-sown cereals grown intensively within small 'garden' plots set in a largely uncleared, wooded and swampy landscape, an environment unsuitable for the extensive grazing of sheep, which does not thrive in damp ground nor woodland. During the growing season for cereals, i.e. winter and spring (Bogaard *et al.,* chapter 23), the time of year that microwear will reflect, grazing land in the immediate vicinity of Ecsegfalva is thus likely to have been restricted in nature and grazing in excess of carrying capacity may have been difficult to avoid, particularly as annual spring floods would have further reduced grazing availability in the flood plain (see chapters 4–6). The herding of grazing animals on marginal land may be further supported by legume seeds recovered within the occupation layers (Bogaard *et al.,* chapter 23); these are considered indicative of sheep/goat grazing on seepage ditches or drainage channels, but could also derive from stubble grazing (Amy Bogaard, *pers. comm.*).

The absence of summer and early autumn-culled individuals in the sample studied makes it impossible to assess using microwear how animals were being managed at that time of the year, as microwear will only reflect diet over a period of 0–3/4 weeks before death (Mainland 1998b). It is intriguing, however, that the absence of summer and autumn-culled animals coincides with a period when grazing availability would have been increased in the vicinity of Ecsegfalva due both to the possibility of stubble grazing after harvest and the recession of flood waters, and while it may indicate that juvenile ovicaprines were herded (and slaughtered) further afield, on outlying open pastureland more conducive to sheep herding, the apparent lack of slaughter during summer and autumn may equally underline the importance of the living sheep in maintaining levels of soil fertility on the arable fields. The question of seasonal variation in diet and how it relates to herd mobility during the Neolithic can only really be resolved, however, by exploring sheep/goat foraging behaviour at a regional level in the Great Hungarian Plain and is clearly a key agenda for future research in this area.

Chapter 18

ORGANIC RESIDUE ANALYSIS OF POTTERY VESSELS

Oliver E. Craig, Carl Heron, Laura H. Willis, Nur Yusof and *Gillian Taylor*

Introduction

In European prehistory, it has long been recognised that molecular and isotopic analysis of remnant organic matter trapped within the fabric of unglazed pottery sherds has the potential to transform dietary and economic investigations of the past (Hodder 1990, 204; Sherratt 1997). Animal fats, plant oils, plant waxes and animal proteins have all been recovered from ceramic vessels buried for thousands of years (Evershed *et al.* 1999; Craig *et al.* 2000). Much of this work has focused specifically on characterising lipids using a range of analytical techniques including gas chromatography (GC) and GC-mass spectrometry (GC-MS).

Using these methods, the lipid profile from an extracted archaeological residue is compared with modern standards and laboratory degraded reference materials to determine the origin of the residues. A detailed understanding of the mechanisms of lipid degradation, both during use and after deposition, and consequently of the likely degradation products is required to interpret these profiles. For example intact fats such as triacylglycerols (TAGs), whose profile may be matched to specific foodstuffs, are very rarely recovered unaltered from archaeological ceramics. Much more commonly encountered are their degradation products, di-, monaclylglycerols and free fatty acids. These may be used to broadly assign the residue to a particular food category (e.g. animal fat, plant oil or plant wax). Occasionally, the presence of a single biomarker can be used to more specifically identify the source of the residue (e.g. Charters *et al.* 1993).

Recent technological advances have allowed the isotopic composition of more frequently encountered lipid compounds to be investigated, using GC-combustion isotope ratio mass spectrometry (GC-C-IRMS). This has provided much more scope for specifically identifying foodstuffs. Notably isotopic measurements have been made on fatty acids to distinguish different animal fats, i.e. ruminant fats, non-ruminant fats, dairy fats and mixtures of these (Dudd and Evershed 1998; Copley *et al.* 2003). Recent applications of these methods to ceramic assemblages from Neolithic sites in the UK have shown that lipids survive on material dating at least to the mid-4th millennium BC (Copley *et al.* 2003). The overwhelming majority of these residues were derived from animal fats, including a large proportion of dairy fats. This study provided some confidence that lipids could be recovered from the Neolithic ceramic assemblages. Determining the presence of milk fats is also particularly desirable considering the difficulties of interpreting dairying from faunal remains (see Halstead 1998).

Aims

1. To characterise the degree of preservation of lipids on pottery dating to the earlier sixth millennium cal BC from the Danube basin
2. To distinguish any preserved animal fats using GC-C-IRMS
3. To gain information concerning culinary and economic practices at Körös culture sites

Due to the integrated nature of the project, there was an excellent opportunity to examine material that had undergone the minimum of conservation. A selection of sherds (see *Table 18.1* for descriptions) and associated soil samples were chosen during excavation specifically for residue analysis and were not washed or excessively cleaned. The samples chosen were from excavated Trenches B and C and were representative of the broader assemblage (see Oross, chapter 27, on the pottery).

Materials and methods

Lipids were extracted from the potsherds and analysed using standard laboratory protocols (Charters *et al.* 1997; Dudd *et al.* 1999).

Solvent extraction and derivatisation

Sherds were first cleaned using a high speed drill to further eliminate any possible contamination derived from the soil or handling during excavation. Ceramic was then removed from the interior surface of the sherds with a modelling drill (2–4 mm in depth). Samples were also taken from the vessel's exterior surface to provide negative controls. Procedural blanks were also included in all subsequent analyses. A number of soil samples, either adhering to the sherds themselves or from the same context were also analysed to assess post-depositional contamination. To each sample (1–2 g) a known amount of internal standard was used in order to assess recovery and quantify the amount of lipid in the extract. Lipids were ultrasonically extracted with mixture of chloroform and methanol (2:1 v:v; 3 × 10 ml × 30 min). The solvent extract was reduced to a small volume by rotary evaporation, removed to a vial and gently dried under nitrogen. A portion of these solvent extracts were treated with 20 μl of *N,O*-bis (trimethylsilyl) trifluoroacetamide containing 1% v/v trimethylchlorosilane at 65°C for 30 minutes to produce trimethylsilyl derivatives which were then dried under nitrogen. These derivatised extracts were dissolved in hexane and analysed by GC and GCMS.

Another portion of the solvent extracts were saponified with NaOH (5% wt/vol in methanol; 70°C; 1 h) to release free fatty acids. The solution was acidified with HCl (6M) and free fatty acids were extracted with hexane and dried under nitrogen. These were then methylated with 2 ml of boron trifluoride-methanol complex (14% wt/vol; 70°C; 1h; BDH, Poole, UK). The resulting fatty acid methyl esters (FAMEs) were extracted with diethyl ether prior to analysis by GC-C-IRMS.

Alkali saponification

Several of the ceramic samples were re-extracted by alkaline saponification *(Table 18.1)* to release higher quantities of lipid for subsequent analyses (see Stern *et al.* 2000; Craig *et al.* 2004). Powdered ceramic (0.5 g, that has already undergone solvent extraction) were extracted with KOH (15 ml; 5% wt./vol in methanol) for 3 hrs at 70°C. After cooling, the supernatant was then

Table 18.1. Description of materials analysed and summary of results
(n/d = none detected. FA = fatty acids detected, DAG = diacylglycerols, TAG = triacylglycerols, KT = long chain ketones, * = potsherds were re-extracted by alkaline saponification. These yielded a range of lipids including fatty acids and alcohols. Soil samples (not shown) either produced no lipid or else small amounts of degraded plant lipids; migration of lipids between pots containing lipids and their surrounding soil was insignificant)

Sample #	Area	Sample Description	Lipids Detected	Analysed by GC-C-IRMS
10042	23B	Body fragment	n/d	no
1219	23A	Body fragment	n/d	no
1244	23A	Body fragment	n/d	no
13075	23B	Rim fragment of medium thickness	n/d	no
13195	23B	Thin walled base fragment. Possible incised pattern on outer wal	n/d	no
13299	23B	Thin walled, plain rim fragment. Straight profile	n/d	no
13604	23B	Very large body fragment of medium thickness. Relief pattern on outer wall	n/d	no
14070	23B	Thin walled, plain body fragment	n/d	no
14102	23B	Very thick base fragment	n/d	no
14155	23B	Thick walled base fragment	n/d	no
14183	23B	Thick walled, plain body fragment of medium size	n/d	no
14431	23B	Thick walled, rim fragment	n/d	no
14435	23B	Thick walled, rim fragment	n/d	no
14456	23B	Thin walled, plain rim sherd of medium size	FA, KT, TAG	yes*
14456		*exterior of above*	n/d	no
14457	23B	Thin walled body fragment of medium size. Relief pattern on outer surface	FA, KT, TAG	yes*
14457	23B	*exterior of above*	n/d	no
14540	23B	Medium walled, plain body fragment	n/d	no
14679	23B	Medium walled, base fragment	FA	yes
14692	23B	Medium, walled body fragment	n/d	no
14693	23B	Thick walled, body fragment	n/d	no
14695	23B	Thick walled, body fragment	n/d	no
14839	23B	Medium walled plain rim fragment with a smooth finish	FA, DAG, TAG	yes*
14839		*exterior of above*	n/d	no
1559	23A	Base fragment	n/d	no
1594	23A	Body fragment	n/d	no
3643	23B	Base fragment	n/d	no
4285	23B	Body fragment	n/d	no
4373	23B	Rim fragment	FA, TAG (tr)	no
4374	23B	Base fragment	FA, TAG(tr)	yes
4576	23B	Rim fragment	n/d	no
5094	23B	Body fragment	FA, TAG	yes
7028	23B	?	n/d	no
7088	238	Rim fragment	n/d	no

Table 18.1. Continued

Sample #	Area	Sample Description	Lipids Detected	Analysed by GC-C-IRMS
7199	238	Base fragment	n/d	no
7389	238	Rim fragment	n/d	no
7546	23B	Body fragment	n/d	no
7919	23B	Body fragment	n/d	no
8024	23B	Body fragment	n/d	no
8280	238	Base fragment	n/d	no
9546	23C	Thick walled body fragment. Relief pattern on outer surface	n/d	no
9562		Thick walled body fragment	n/d	no
9563	23C	Thick walled body fragment with incised pattern on outer surface	n/d	no
9664	23C	Thick walled, body fragment of relatively large size. Incised pattern on outer surface.	FA, KT, TAG	yes*
9664		*exterior of above*	n/d	no

acidified to pH 2.0 with 6M hydrochloric acid (HCl) and the liberated lipid components were then extracted with hexane (5 × 5 ml). After the addition of an internal standard, derivatisation was carried out for both GC/GC-MS and GC-C-IRMS, as described above for solvent extracts.

High temperature gas chromatography (GC); Gas chromatography mass spectrometry (GC-MS)

Solvent extracts were initially screened for the presence of lipids by GC on a Hewlett Packard 6890 gas chromatograph, fitted with a DB-1ht (J & W Scientific) coated (0.1 μm) fused silica column (14 m × 0.32 mm ID). The GC was equipped with a flame ionisation detector (FID) and split/splitless injector. Helium was the carrier gas with a head pressure of 25 psi at room temperature and a constant flow rate of 0.5 ml/min. The injector and FID were maintained at 300°C and 340°C respectively. The initial temperature of the oven was 50°C and then programmed to increase 10°C/min until it reached 220°C, then 5°C/min until it reached to 340°C, which was finally maintained for 12 minutes. Where the GC elution order was insufficient to identify all the compounds GC-MS was carried out using a Hewlett Packard 5890 series II GC connected to a HP 5972 series mass selective detector. Helium was the carrier gas, with a constant head pressure of 1 psi and a flow rate of 1 ml/min at 50°C. The injector and interface were maintained at 330°C and 340°C respectively. The initial temperature of the oven was 50°C and then programmed to increase 10°C/min until it reached 220°C, then 5°C/min until it reached to 340°C, which was finally maintained for 12 minutes. The column was directly inserted into the ion source. Electron impact (EI) spectra were obtained at 70eV with full scan from 50 to 700 *m/z*.

Gas chromatography combustion isotope ratio mass spectrometry (GC-C-IRMS)

Ceramic samples which contained detectable amounts of 18:0 (stearic) and 16:0 (palmitic) fatty acids were chosen for GC-C-IRMS analysis (see *Table 18.1*). These compounds were methylated, as described above, to produce FAMEs and were analysed using a Hewlett Packard 5890 gas chromatograph attached to a isotope ratio mass spectrometer (PDZ Europa Ltd Geo; Crewe, UK) via a Orchid II combustion interface (PDZ Europa Ltd; Crewe, UK). Analysis was performed using a 30 m × 0.32 mm I.D. fused-silica column coated with BPX70 stationary phase (immobilised 70% cyanopropyl equivalent polysilphenylene-siloxane; 0.25 μm film thickness; SGE, Milton Keynes, UK). The temperature program was as follows: 130°C (2 min); 130°C–190°C at 4°C/min; 190°C (2 min). Helium was used as the carrier gas at a head pressure of 9.6 p.s.i. The combustion furnace was maintained at 860°C and the mass spectrometer source pressure was 7.6^{-6} Torr. The values were corrected for the derivatisation process by comparing with measurements obtained by isotope ratio mass spectrometry on purified preparations of a number of individual *n*-alkanoic acids (Sigma; UK). Carbon isotopes were expressed relative to the PDB standard, $\delta^{13}C = 1000\ [(R_{sample}/R_{standard} - 1]$, where R is $^{13}C/^{12}C$ in per mil (‰). Extracts from all samples were run at least in triplicate. All the modern samples were corrected for the effects of fossil fuel burning (Friedli *et al.* 1986).

Results

The results of the lipid analysis are summarised in *Table 18.1.*

Seven out of 41 samples sherds yielded appreciable amounts of lipids by solvent extraction. The amounts of lipid on these sherds were consistently low with less than 500 μg *(Table 18.2)* except for sherd 9664 (~1.37 mg g^{-1}). Nevertheless, the amount of lipid absorbed in the interior sherd surfaces was significantly greater than the exterior samples indicating that the recovered residue was associated with vessel use. Typical chromatograms obtained from solvent extracts of sherds and analysed by GC-MS and GC are shown in *Figs 18.1–3*, respectively. The most dominant compounds in each of the eight solvent extracts were saturated fatty acids, notably palmitic acid (C16:0) and stearic acid (C18:0). The C16:0 to C18:0 ratio ranged from 0.41 to 1.16 *(Table 18.2).* Although these fatty acids are found in a range of plant and animal foodstuffs, the high relative amount of the stearic acid component is typical of animal fats. The C16:0 to C18:0 ratio in plant tissues is usually greater than 3. The absolute ratio of C16:0 to C18:0 can however be distorted by post-depositional preferential dissolution, by percolating groundwater, of the lighter C16:0 component (Bell 1973), and this has undoubtedly occurred in samples with a C16:0 to C18:0 ratio of less than 1. The presence of trace amounts of cholesterol, a biomarker specific for animal tissues, in one of the vessels (5094) is consistent with the fatty acid data *(Fig. 18.1).* The minor fatty acid components also provide further clues to the origin of the residues. Saturated fatty acids with branched and odd-number carbon chains (e.g. C17:0; C17:0 Br) were detected in all of the sherds, except 14839. These lipids are characteristic of fats from ruminant animals although they can also be bacterially derived.

Table 18.2. Summary of total amounts of lipid in solvent extracts and ratio of major saturated fatty acids

Sample #	Total Lipid (ug/g sherd)	$C_{16:0}/C_{18:0}$
9664	1372	0.49
14457	201	1.16
14456	164	0.80
14839	178	0.41
5094	500	1.12
14679	122	0.62

The presence of intact triacylglycerols in several sherds *(Figs 18.1–4)* is remarkable considering the length of exposure in the burial environment (c. 7,500 years). Whilst it is likely that only components with the highest molecular weight from the original suite of triacylglycerols remain, the presence of components with less than 48 carbon atoms *(Fig. 18.4)*, identified in three of the sherds, is further indication that these absorbed residues derive from ruminants. Triacylglycerols with less than 48 carbon atoms are at very low abundance in non-ruminant fats (Enser 1991).

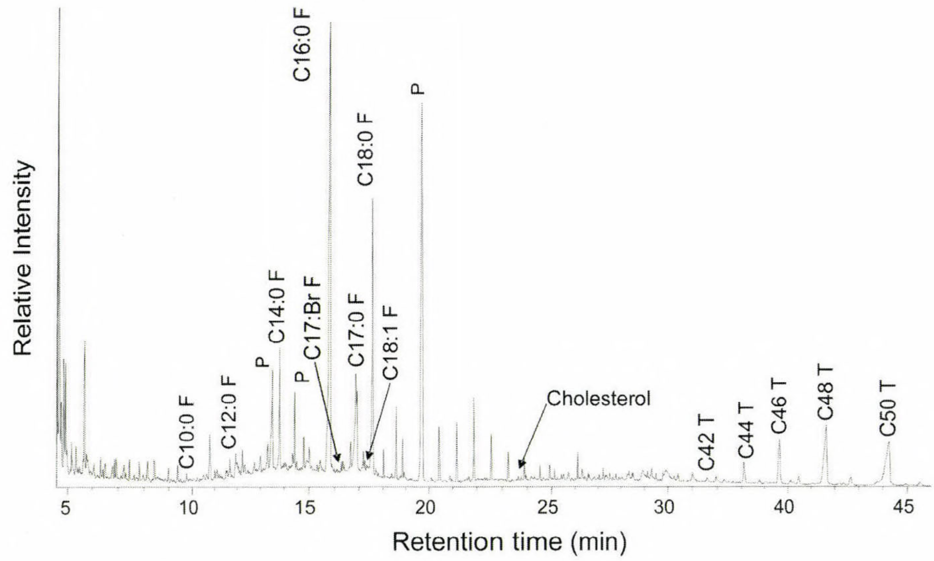

Fig. 18.1. Total ion current chromatogram of partly degraded animal fat solvent extracted from sherd 5094. Cx:y F refer to fatty acids with carbon number (x) and number of unsaturations (y). Cx T refer to triacylglycerols with number of carbon atoms (x). P = plasticisers

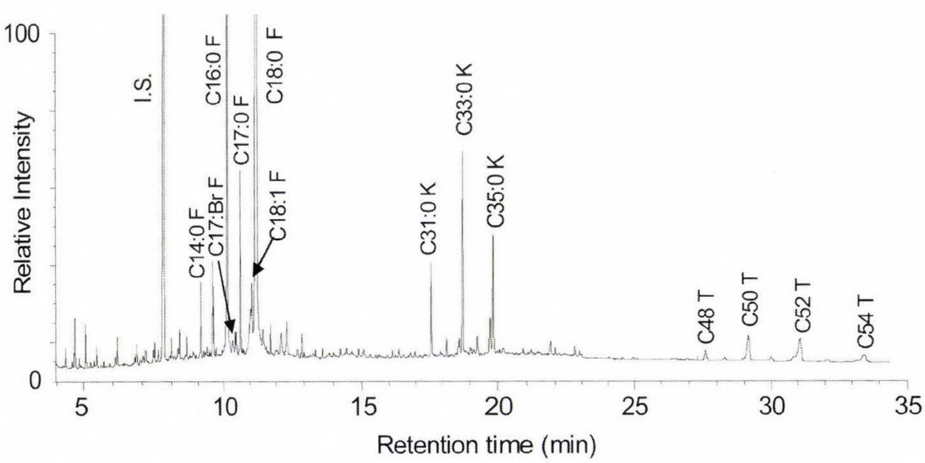

Fig. 18.2. Partial gas chromatogram of partly degraded animal fat solvent extracted from sherd 9664. Cx:y F and Cx:y K refer to fatty acids and mid chain ketones respectively with carbon number (x) and number of unsaturations (y). Br = branched chain fatty acids. Cx T refer to triacylglycerols with number of carbon atoms x. i.s = internal standard (hexadecane – 10 μg). The chromatogram, dominated by fatty acids, is re-scaled to highlight the minor lipid components

Three of the Ecsegfalva sherds also contained a range of un-branched mid-chain ketones *(Table 18.1; Figs 18.2–3)*. The number of carbon atoms and position of carbonyl group in these compounds and their relative abundances suggest that they were formed by condensation of free fatty acids within the vessel wall, during cooking (Raven *et al.* 1997). Similar distributions of ketones have been observed in other archaeological cooking wares (e.g. Evershed *et al.* 1995) and in replica pots used to boil beef over an open fire (Stacey 1999). No correlation was observed between pots containing ketones and exterior soot-marks.

Analysis of modern reference fats have shown that differences in the ratio of ^{13}C to ^{12}C ($\delta^{13}C$) in individual fatty acids can be used to distinguish different animal products (Dudd and Evershed 1998; Copley *et al.* 2003). The stable carbon isotope ratios of the major saturated fatty acids

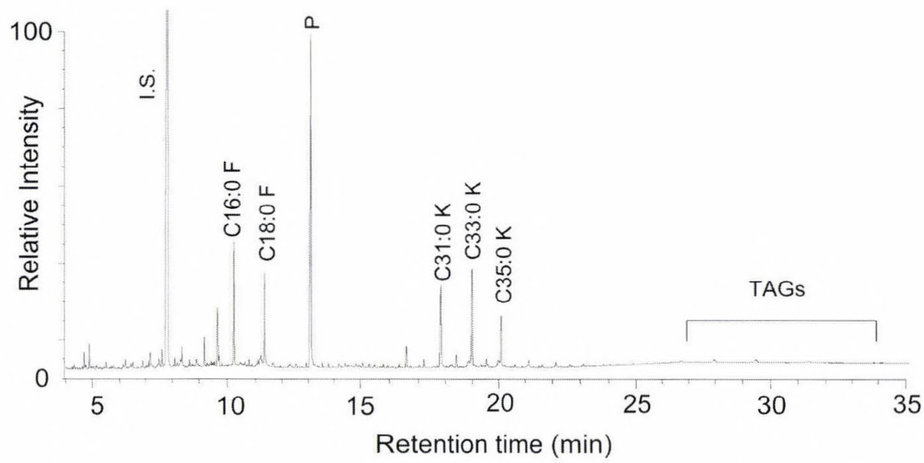

Fig. 18.3. Partial gas chromatogram of partly degraded animal fat solvent extracted from sherd 14457. Cx:y F and Cx:y K refer to fatty acids and mid chain ketones respectively with carbon number (x) and number of unsaturations (y). i.s = internal standard (hexadecane – 10 μg). P = plasticisers. The chromatogram, dominated by fatty acids, is re-scaled to highlight the minor lipid components

(C16:0 and C18:0) extracted from the Ecsegfalva sherds are plotted with a range of controls, modern standards and previously published reference materials (Dudd *et al.* 1999) in order to further determine the origins of these residues *(Fig. 18.5)*. The absolute isotope ratios of these fatty acids in milk are a function of the animal's diet (see *Fig. 18.5*), but in all cases the $\delta^{13}C$ value of the C18:0 fatty acid in modern ruminant milk is between 3.3–7‰ lighter than the C16:0 (Copley *et al.* 2003); this difference is commonly expressed as $\Delta^{13}C$, where $\Delta^{13}C = (\delta^{13}C_{18:0}) - (\delta^{13}C_{16:0})$. In contrast, non-ruminant tissues have $\Delta^{13}C$ value greater than –1‰ and for ruminant adipose fats this value is between –3.3‰ and –1‰ *(Fig. 18.6)*. The $\Delta^{13}C$ values (*Fig. 18.6*, y-axis) therefore indicate that ruminant milk fats, ruminant adipose fats or a mixture of these products were processed in these vessels. It is noticeable that the $\delta^{13}C$ values of both the fatty acids for the samples containing ruminant milk fats are enriched (1–2 ‰) in ^{13}C compared to previously published milk standards (Dudd *et al.* 1999; *Fig. 18.5*). As the modern reference samples were obtained from animals raised on C3 pasture from southern England it is plausible therefore that variation in geographical location and/or diet may explain this discrepancy.

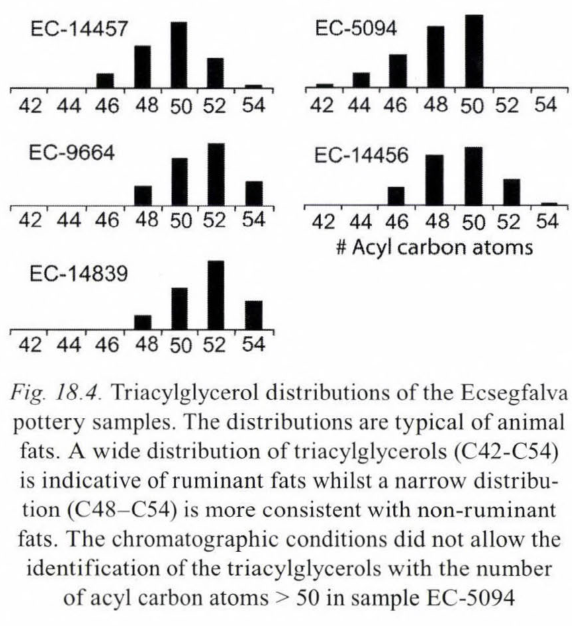

Fig. 18.4. Triacylglycerol distributions of the Ecsegfalva pottery samples. The distributions are typical of animal fats. A wide distribution of triacylglycerols (C42-C54) is indicative of ruminant fats whilst a narrow distribution (C48–C54) is more consistent with non-ruminant fats. The chromatographic conditions did not allow the identification of the triacylglycerols with the number of acyl carbon atoms > 50 in sample EC-5094

Alkali saponification was carried out on several sherds following solvent extraction in order to assess the quantity and quality of any lipids that may exist in a tightly 'bound' form within the residue (Stern *et al.* 2000; Craig *et al.* 2004). Typical gas chromatograms of saponified extracts are shown in *Figs 18.7–8* and summarised in *Fig. 18.9.* Substantial amounts of lipid were further released by saponification *(Fig. 18.9).* We suggest that this fraction was preferentially preserved compared to the organic solvent soluble fraction during burial most likely by polymerisation and thus its solubility was reduced. Also noticeable is the large relative abundance of C18:1 in this

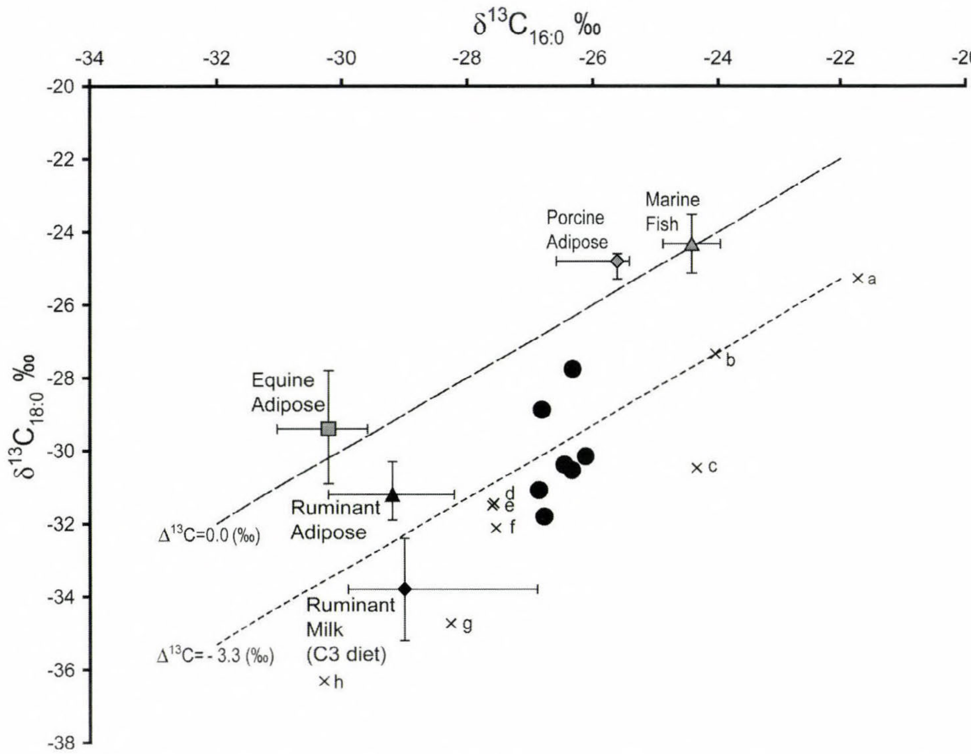

Fig. 18.5. Plot of the $\delta^{13}C$ values of C18:0 and C16:0 fatty acids extracted from Ecsegfalva potsherds (solid circles) control samples and reference milk fats. The latter were obtained by solvent extraction from; a) a modern milk pot from North-western India; b) sheep's milk from Northern England, animals fed supplementary C4 fodders; c) cow's milk from Northern England, animals fed ca. 60% maize silage; d) goat's milk from Northern England, animals fed supplementary C4 fodders; e) boiled cow's milk from Northern England, animals fed supplementary C4 fodders; f) cow's milk from Southern India, animals fed ca. 65% rice bran and 35% sorghum; g) cow's milk from Northern England, animals grazed on purely C3 pasture (same herd as c); h) cow's milk from the Shetland Islands, animals grazed on purely C3 pasture. Despite the variation in these animals' diet and geographical location the Δ13C values are always less than –3.3 ‰ (indicated by small dashed line). These data are further compared with ratios for mammalian reference fats from Dudd *et al.* (1999; *Fig. 18.3*) and oils from marine fish (n = 4). Fatty acid methyl esters (FAMEs) were prepared prior to analysis by GC-C-IRMS by methylation of saponified *solvent* extracts only. Extracts were run at least in duplicate with analytical precision of ±0.3‰

fraction compared to the solvent extract. Whilst this compound is usually associated with plant oils it also occurs at high concentrations in milk and other ruminant products. Usually however this compound is very labile and is degraded into shorter chain unsaturated fatty acid moieties (Regert *et al.* 1998). Its abundance is testament to the remarkable preservation of the 'bound' fraction in these sherds, and thus the suite of fatty acids present may be more representative of the original vessel contents.

Discussion

Only a small number of sherds analysed (17%) contained traces of lipids, a hit rate well below that reported from other Neolithic assemblages (e.g. lipids were detected on c. 50% of vessels from assemblages dating to the fourth millennium cal BC in southern Britain: Copley *et al.* 2003). This is most likely due to the greater antiquity of this material. However, variation in the use of ceramics vessels, whether related to different economic or social practices, and variation in the intentional deposition of particular pots in different contexts must be considered before directly comparing this type of data. It should also be remembered that different pottery uses have different chances

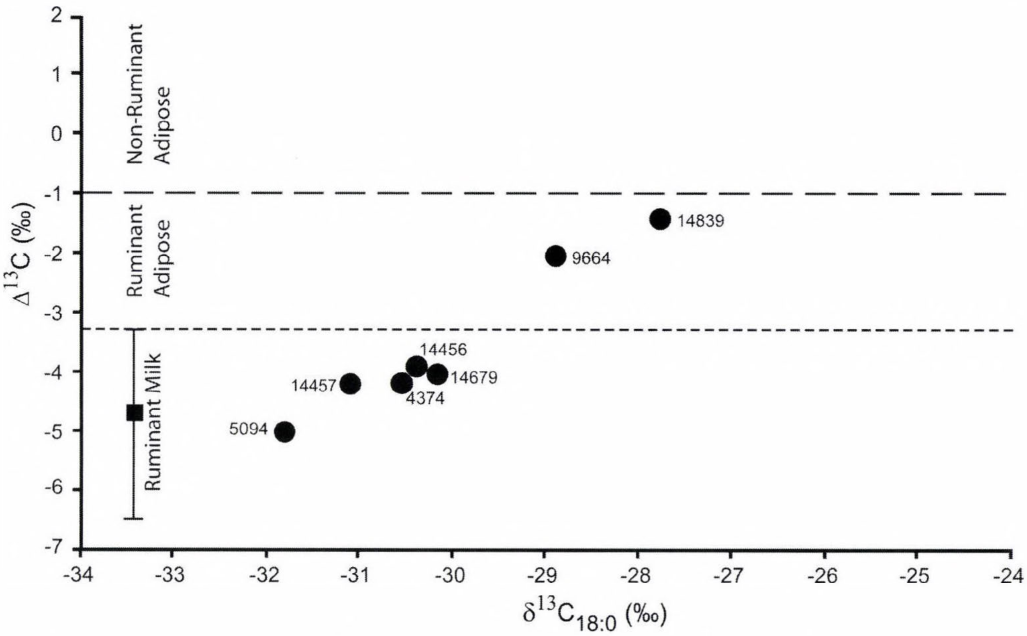

Fig. 18.6. Plot of the offset in $\delta^{13}C$ values of C18:0 and C16:0 fatty acids ($\Delta^{13}C$ value) against the $\delta^{13}C$ value of the C18:0 fatty acid extracted from Ecsegfalva. Significantly The range and mean $\Delta^{13}C$ values obtained from modern ruminant milk samples (plotted in *Fig. 18.5*) is shown (plotted on Y-axis only). The other fields are derived from amalgamated data sets (Dudd *et al.* 1999; Copley *et al.* 2003; Craig, unpublished)

of leaving an absorbed residue. For example, consider a pot that was used daily for several years for boiling milk against a vessel that was occasionally used to store grain. Perhaps it is not surprising therefore that the small number of vessels that did leave a lipid residue was derived from animal products, which are intrinsically lipid-rich. Thus, the absence of plant biomarkers may not be significant considering the small sample size and the antiquity of the material.

The animal fats that were identified were of ruminant origin *(Figs 18.5–6)*, which is entirely consistent with the Ecsegfalva faunal assemblage which is dominated by caprids and to a lesser extent cattle (see Bartosiewicz, chapter 14). Notably, 5 out of 8 of these residues could be securely identified to milk fats. This demonstrates that dairying was practised, to some extent, by one of the earliest European farming communities. The fact that dairying was established in this region as early as the sixth millennium cal BC is reinforced by similar observations of milk lipids on a small number of pots from Schela Cladovei in the Iron Gates gorge (Craig *et al.* 2005). The presence of milk fats and lipid pyrolysis products (i.e. mid-chain ketones) on cooking wares suggest that dairy products were heated, perhaps as part of their processing. The mixing of dairy products with other commodities either at the same time or over the vessel's use-life is also suggested by the heterogeneity of the $\Delta^{13}C$ values *(Fig. 18.6)*.

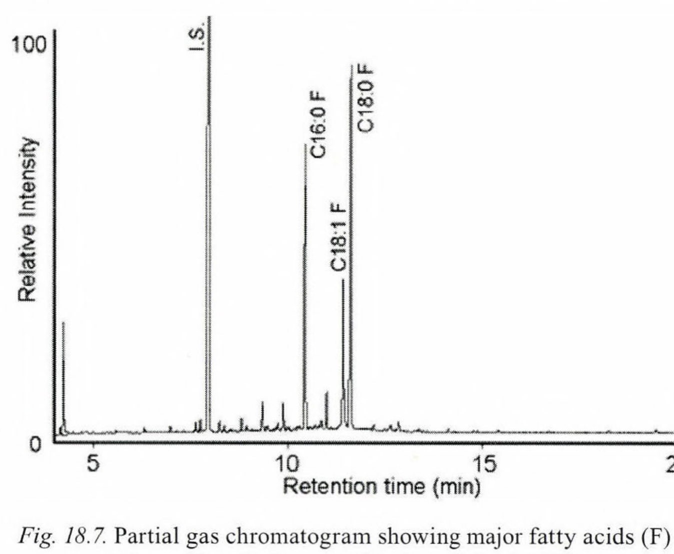

Fig. 18.7. Partial gas chromatogram showing major fatty acids (F) released by alkali saponification of sherd 9664

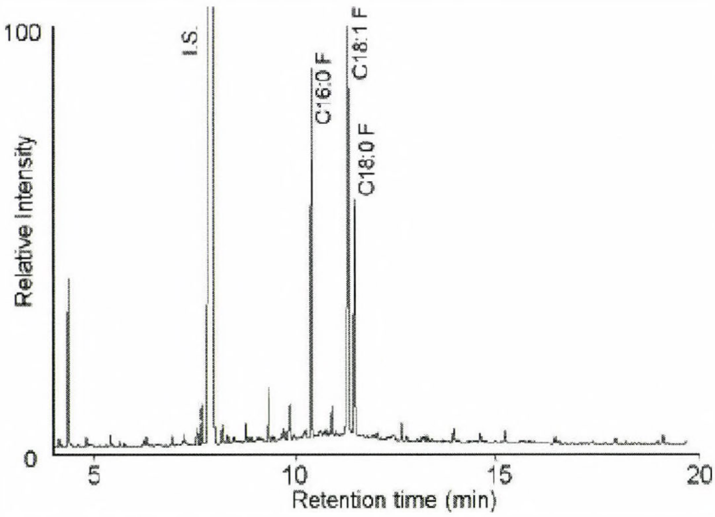

Fig. 18.8. Partial gas chromatogram showing major fatty acids (F) released by alkali saponification of sherd 14457

This study has provided intriguing insights concerning the use of pottery at Ecsegfalva and has shown that the approach can be applied successfully to some of the earliest assemblages. Significantly, we have also demonstrated direct evidence for dairying, a practice which is not evident from the faunal assemblage. These findings lend support to the view that the origins of dairying are associated with the origins of animal domestication and that dairy products were important commodities to Early Neolithic European farmers, as suggested by Bogucki (1984a; 1984b). However, it should also be noted that the identification of small-scale dairying in the Early Neolithic does not necessarily rule out later intensification in the fourth millennium cal BC, as outlined in the secondary products scenario (Sherratt 1981; 1997; Greenfield 1988).

As there is no reason to suppose that dairying was a 'specific technology' that followed strict rules of cultural transmission and diffusion, a third hypothesis is that domestic animals were exploited for milk, to different degrees, throughout the Neolithic, depending on specific cultural, economic and environmental factors. For example, it is reasonable to assume that cattle were only intensively exploited for their milk by populations with greater access to pasture. Indeed, at Ecsegfalva, which lacked extensive pasture, indications point towards small-scale household herding. The arable weed flora on land close to the site indicate that manuring was practised (see

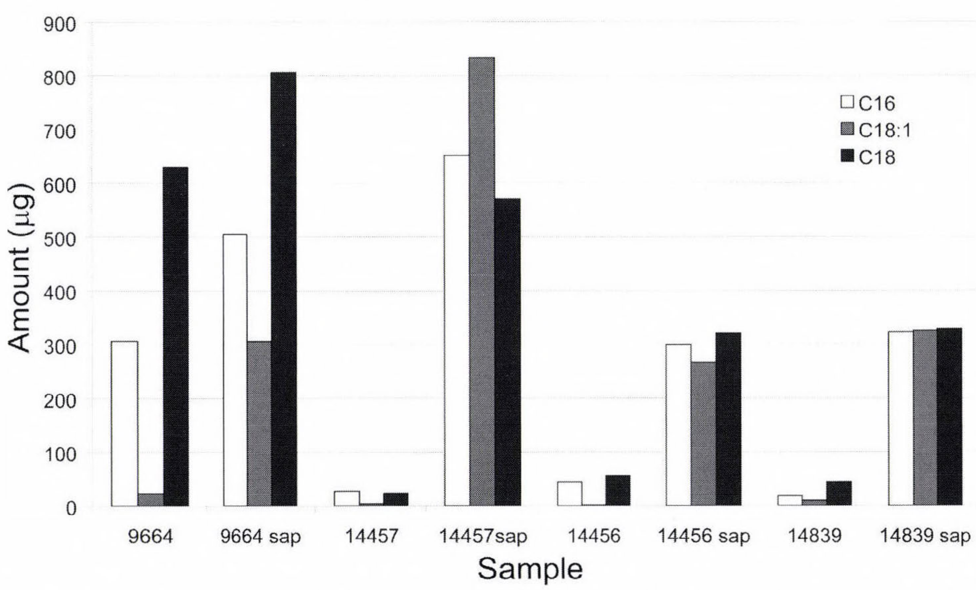

Fig. 18.9. Comparison of quantity and distribution of major fatty acids released by solvent extraction and subsequently alkali saponification (sap). C16 – palmitic acid, C18 – stearic acid, C18:1 – oleic acid)

Bogaard *et al.*, chapter 23). Patterns of microwear suggestive of overgrazing have been observed on the sheep's teeth (see Mainland, chapter 17). Both these indicate the enclosure of animals on restricted patches of land and their integration with other local economic practices, rather than large-scale pastoralism where large numbers of animals were moved around the landscape. Finally it is worth noting that dairy products may have had special significance within the overall economy, because, like grain, they can be stored and accumulated.

Acknowledgement

We thank the Natural Environment Research Council for financial support for this project (GR3/12827).

Chapter 19

BIRD REMAINS

Erika Gál

'There is no flying without wings.'
French proverb (Adler 2001)

Introduction

Avian remains from archaeological excavations in Hungary and neighbouring areas (e.g. Serbia) have been summarised in two articles, from the mid-1960s (Bökönyi and Jánossy 1965) and mid-1980s (Jánossy 1985). In addition, works by Bökönyi (1959; 1974) also list bird remains found at sites in Hungary.

Neither avian nor other animal remains were previously known from the site of Ecsegfalva. Other Körös culture settlements in the region such as Endrőd 39, Endrőd 119 (Bökönyi 1992a), Szajol-Felsőföld or Szolnok-Szanda yielded more or less bird bone material, but insufficient data regarding the number of remains and body part distribution do not allow us any profound comparison between those data and our results. Therefore the aim of this report is a complete presentation and analysis of one of the most important Early Neolithic bird bone assemblages from the Great Hungarian Plain.

Material and method

The bird bone assemblage excavated in Ecsegfalva 23 furnished the richest Neolithic avifauna from Hungary both in terms of the number of identifiable specimens (NISP), minimum number of individuals (MNI) and the number of species identified. The Körös culture material from Endrőd 119 yielded the most abundant prehistoric Hungarian bird bone assemblage in which the number of the excavated bones (607) exceeds, and the MNI (62) associated with the identifiable species is close to, that from Ecsegfalva 23. The great number of non-identifiable remains (545) from Endrőd 119 (Bökönyi 1992a) and the unknown place where this material is deposited, however, makes their direct and detailed comparative analysis impossible.

Even in this case, the bird bone assemblage makes up only 1 per cent of the total 33,000 animal remains from Ecsegfalva 23 *(Fig. 19.1)*. One must take into consideration, however, that owing to anatomical differences, properties of quantification vary between the classes of vertebrates. For example, the great number of fish bones does not indicate nearly as many individuals as would be the case with mammals or birds (Bartosiewicz, chapters 14 and 20).

The great number of bird remains (276 complete and fragmented bones) from Ecsegfalva 23 is obviously due to modern excavation methods: the careful collection of remains, as well as dry and wet sieving of the material. Every single bone was labelled, indicating the level and context where it had come from. The surface of the remains is often damaged but the bones usually hold the most important morphological features needed for identification. It is important to notice that every fragment, even those recognised only as 'Aves indeterminate' were included in data analysis (e.g. skeletal representation) and results. Further taphonomic observations are discussed below.

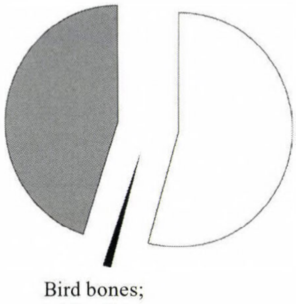

Fig. 19.1. Distribution of animal bones in Ecsegfalva 23, Trenches A, B and C (n > 33,000)

The identification of bones was made using the recent comparative bird bone collection in the Hungarian Natural History Museum (Budapest) and in the Zoological Museum of University of Copenhagen. In addition to morphological comparison, osteometric data found in the literature and in my own dataset helped the accurate identification of remains. In the case of some fragments and bones of related species, however, these aids were not sufficient, and the remains could be identified only to the genus- or order-level, or simply left 'Aves indeterminate'. The bones were measured with a digital calliper and all measurements and data were entered into a database. The sizes of complete skeletal parts as well as measurable fragments are summarised in *Appendix Table 19.I.* For the taxonomic classification and main environmental characteristics of the recognised bird species I used Cramp's CD-ROM (Cramp 1998).

The avifauna

The 276 bird bones studied yielded 52 taxa. Among these taxa, 40 could be recognised to species level, five to genus level, one to family level and two to order level. The species list and the related number of identifiable specimens (NISP) and MNI are summarised in *Table 19.1.*

Table 19.1. Bird species identified at Ecsegfalva 23
(Abbreviations: NISP = number of identifiable specimens; MNI = minimal number of individuals)

No.	Species	English name	NISP	MNI
1.	*Podiceps cristatus*	Great crested Grebe	5	1
2.	*Botaurus stellaris*	Bittern	2	1
3.	*Nycticorax nycticorax*	Night Heron	2	1
4.	*Egretta alba*	Great White Egret	2	1
5.	*Ardea cinerea*	Grey Heron	4	2
6.	*Ardea purpurea*	Purple Heron	8	1
7.	*Platalea leucorodia*	Spoonbill	2	1
8.	*Anser* cf. *anser*	Grey-lag Goose	4	2
9.	*Anas* cf. *strepera*	Gadwall	7	4
10.	*Anas crecca*	Teal	8	1
11.	*Anas platyrhynchos*	Mallard	33	6
12.	*Anas* cf. *acuta*	Pintail	3	1
13.	*Anas querquedula*	Garganey	6	2
	Anas querquedula/A. clypeata	Garganey/Shoveler	1	1
	Anas sp. indet.	Unidentifiable duck	10	?
14.	*Aythya ferina*	Pochard	3	1
15.	*Aythya nyroca*	Ferruginous Duck	17	3
16.	*Aythya fuligula*	Tufted Duck	2	1
	Aythya ferina/A. fuligula	Pochard/Tufted Duck	1	1
	Aythya sp. indet.	Unidentifiable Pochard	1	1
17.	*Mergus* cf. *merganser*	Goosander	1	1
	Anseriformes indet.	Unidentifiable geese and ducks	21	?

Table 19.1. Continued

No.	Species	English name	NISP	MNI
18.	*Circus sp.* indet.	Unidentifiable harrier	1	1
19.	*Accipiter gentilis*	Goshawk	1	1
20.	*Buteo buteo*	Buzzard	1	1
21.	*Hieraaetus pennatus*	Booted Eagle	1	1
22.	*Tetrao tetrix*	Black Grouse	2	1
23.	*Perdix perdix*	Partridge	1	1
24.	*Porzana porzana*	Spotted Crake	1	1
25.	*Gallinula chloropus*	Moorhen	1	1
26.	*Fulica atra*	Coot	14	2
27.	*Grus grus*	Crane	1	1
28.	*Otis tarda*	Great Bustard	1	1
29.	*Scolopax rusticola*	Woodcock	1	1
30.	*Limosa limosa*	Black-tailed Godwit	1	1
31.	*Columba palumbus*	Woodpigeon	24	4
32.	*Strix aluco*	Tawny Owl	1	1
33.	*Coracias garrulus*	Roller	1	1
34.	*Dendrocopus major*	Great Spotted Woodpecker	1	1
35.	*Alauda arvensis*	Skylark	1	1
36.	*Turdus merula*	Blackbird	1	1
37.	*Turdus viscivorus*	Mistle Trush	1	1
	Turdus sp. indet.	Unidentified trush	2	?
38.	*Acrocephalus sp.* indet.	Unidentified warbler	1	1
39.	*Garrulus glandarius*	Jay	1	1
40.	*Pica pica*	Magpie	1	1
41.	*Corvus frugilegus/C. corone*	Rook/Carrion Crow	2	1
42.	*Sturnus vulgaris*	Starling	6	2
43.	*Passer domesticus*	House Sparrow	2	2
	Emberizidae indet.	Unidentifiable buntings and allies	2	?
	Passeriformes indet.	Unidentifiable passerine	3	?
	Aves indet.	Unidentifiable bird bones	56	?
Total			276	65

The species identified range from small to large birds, and belong to 12 orders: grebes (Podicipediformes, 1 taxon); storks, herons and bitterns (Ciconiiformes, 6 taxa); geese and ducks (Anseriformes, 15); diurnal birds of prey (Accipitriformes, 4); Black Grouse and Partridge (Galliformes, 2); rails, Crane and Great Bustard (Gruiformes, 5); wading- and cursorial birds (Charadriiformes, 2); Woodpigeon (Columbiformes, 1); Tawny Owl (Strigiformes, 1); Roller (Coraciiformes, 1); Great Spotted Woodpecker (Piciformes, 1); and perching birds (Passeriformes, 12) (Cramp 1998).

Many of the taxa are identified for the first time from the Hungarian Neolithic: Bittern (*Botaurus stellaris*), Night Heron (*Nycticorax nycticorax*), Gadwall (*Anas* cf. *strepera*), Pintail (*Anas acuta*), Goosander (*Mergus merganser*), Goshawk (*Accipiter gentiles*), Buzzard (*Buteo buteo*), Booted Eagle (*Hieraaetus pennatus*), Spotted Crake (*Porzana porzana*), Moorhen (*Gallinula chloropus*), Woodcock (*Scolopax rusticola*), Black-tailed Godwit (*Limosa limosa*), Roller (*Coracias garrulus*), Great Spotted Woodpecker (*Dendrocopus major*), Skylark (*Alauda arvensis*), Blackbird (*Turdus merula*), Mistle Trush (*T. viscivorus*), warbler (*Acrocephalus sp.*), Jay (*Garrulus glandarius*), Magpie (*Pica pica*), Starling (*Sturnus vulgaris*) and House Sparrow (*Passer domesticus*) (Jánossy 1985).

With the exception of Pintail and Mistle Trush (Petreşti culture level of Ungurului Cave, Romania), Goosander (Vinča culture level of Parţa, Romania), Goshawk (Suplacu de Barcău, Romania), Magpie (the Körös culture site of Ludas-Budzsák, Serbia and from Cladova, Romania), the above mentioned species are described from the Neolithic of the Carpathian Basin for the first time (Jánossy 1985; Jurcsák and Kessler 1986; Kessler and Gál 1998; Gál 2004).

Palaeoenvironmental reconstruction

Many scholars have discussed the importance of bird remains from archaeological sites. Beside the symbolic value of birds, aspects of classification (Morales Muńiz 1993), avian palaeoecology (Morales Muńiz 1993; Eastham 1997) and seasonality (Serjeantson 1998) are perhaps the most important topics in archaeo-ornithology.

Many ecotypes can be distinguished among the numerous species identified from Ecsegfalva 23 *(Fig. 19.2)*. The most frequent bird bones originate from various types of ducks. Dabbling ducks (*Anas*) and diving ducks (*Aythya* and *Mergus*) are equally found amongst these waterfowls. All the recognised species are associated with shallow or slow-flowing waters of lakes or river systems.

Dabbling ducks are surface feeders, adapted to biologically productive waters with ample vegetation. Some species such as Gadwall are primarily vegetarian both on land and in shallow water. Others, for instance Teal (*A. crecca*) and Mallard (*A. platyrhynchos*), are omnivorous, taking mainly seeds and invertebrates from shallow water by dabbling at the surface. The breeding site of this group of birds is made by females on the ground, hidden under thick cover often well away from the water; or in cavities of trees (Cramp 1998).

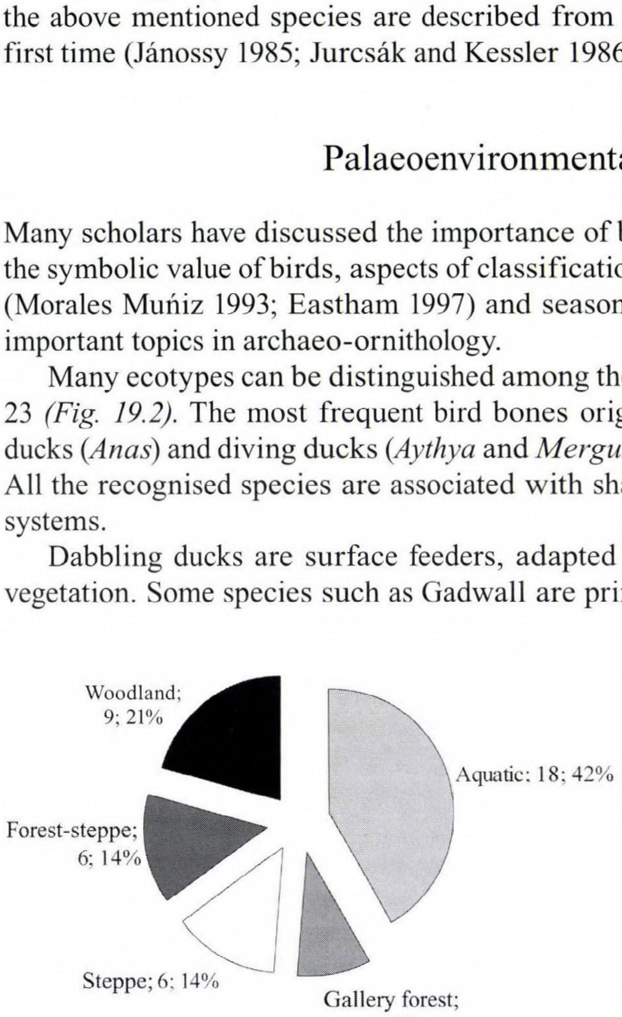

Fig. 19.2. Ecological characteristics of the bird taxa identified from Ecsegfalva 23 (n = 43)

Pochards (Aythyni) are medium sized fresh water diving ducks. All three species identified – Pochard (*Aythya ferina*), Ferruginous Duck (*A. nyroca*) and Tufted Duck (*A. fuligula*) – are omnivorous. They feed on stationary or slow-moving plants and animals, usually collected from the bottom by diving. The nest of these species is built also by females, over shallow water or on ground never far from water, usually in thick cover.

Although sawbills (*Mergus*) commonly are plunging ducks, Goosander obtains its food, usually consisting of fish, by surface diving, using legs only for propulsion. It also forages with its head submerged.

The true diver Great crested Grebe (*Podiceps cristatus*) prefers 0.5–5 m deep, cool to cold, standing fresh or brackish waters, usually with flat or sloping banks and muddy or sandy bottoms, affording considerable open areas. It feeds chiefly on fish. The nest is made in water, well hidden among reeds or other aquatic vegetation.

In addition to the rich group of wildfowl (Anatidae) many wading birds are also adapted to swampy environments. Spotted Crake prefers very shallow fresh water, rich in invertebrate food. For breeding, it needs the cover of stands with ample vegetation close to or standing in water. Coot (*Fulica atra*) is found both in standing water and shallow flowing rivers. It requires a minimum of open water. Plant material dominates its diet, and is also used for building the nest in shallow water.

Stork-like birds (Ciconiiformes) such as Bittern, Great White Egret (*Egretta alba*), Purple Heron (*Ardea purpurea*) and Spoonbill (*Platalea leucorodia*) are restricted to lowland swamps and densely vegetated wetlands. These birds feed on small vertebrates (e.g. fish, lizards and small mammals) as well as invertebrates and their larvae in shallow standing water in or near cover. For breeding they prefer dense reed beds and similar masses of emergent plants. Spoonbill sometimes may nest on scattered shrubs or trees such as willows and poplars.

Some waders belonging to this latter order, Ciconiiformes, are more arboreal and less often breed in reed beds. Both Night Heron and Grey Heron (*Ardea cinerea*) prefer margins of shallow, fresh standing or gently flowing water. Their food consists of fish and other small vertebrates, and invertebrates. These herons need waterside trees or bushes when resting, roosting, or nesting. Grey Heron usually make their nests in tall trees up to 25 m above ground.

Moorhen is also markedly arboreal. It requires access to open fresh water with adequate plant cover. Its expansion overlaps with Coot along margins of lakes and rivers with both cover and open areas readily accessible from water. Moorhen is omnivorous with varying proportions of plant- and animal materials in its diet.

Other birds identified from Ecsegfalva 23 are associated with bogs and fen, or with dry or wet steppe. They nest on the ground, in the reed bed or in hollows (Grey-lag Goose or Crane), or in the cover of lower (Great Bustard, Black-tailed Godwit and Skylark) or taller (Black Grouse) vegetation, like trees or shrubs. Grey-lag Goose (*Anser anser*) likes wetlands, inaccessible swamps and reed-beds. A combination of secure aquatic and open grassland habitats is required by this species. It forages over grasslands, croplands, and in swamps, as well as in shallow water.

Black Grouse (*Tetrao terix*) can be found in transitional habitats between forest and open heath, or in steppe. The presence of trees is essential and should preferably be in scattered groups of no great height. Its diet consists predominantly of plants (buds, needles, cones of pines, catkins and grasses) throughout the year, but small amounts of animal material, especially during the summer, are also taken.

In our latitude, Crane (*Grus grus*) typically breeds in reedy wetland as well as in steppe areas, but is always associated with water. Its food, taken from the ground, shallow water, or low vegetation, includes roots, stems, leaves, fruits and seeds. Animal prey, mainly invertebrates, is also taken and may predominate during the summer.

Black-tailed Godwit is often associated with moorlands or grass marshes and damp meadows, boggy grassy lakeshores, or damp grassy depressions in steppe environments. This bird eats chiefly invertebrates, and also plant material in winter and on migration.

Great Bustard (*Otis tarda*) is strongly attached to river valleys and undulating open country. It feeds mainly on plants, grazing young shoots, leaves, flowers, and seeds. It occasionally eats invertebrates and small vertebrates as well. Partridge (*Perdix perdix*) and Skylark inhabit moist open surfaces preferably well covered with grasses (including cereals) or low green herbage. Animal prey is taken mainly during the summer, while plant materials, especially cereals, during the spring and autumn, and weed seeds in winter. All these three species make their nests on the ground, in low grass or crops.

Many identified species are birds that live in wooded environments. Here one can also distinguish two habitats: forests and the edges between open ground and woodland, or open fields with scattered trees. Some birds such as Buzzard, Roller, Magpie, Rook or Carrion Crow (*Corvus* *frugilegus/C. corone*), Starling and House Sparrow like this latter kind of environment. These birds perch and scan the surroundings or soar over open fields. Buzzard principally consumes small vertebrates, completed with invertebrates. Magpie, Crows and Starling eat mainly invertebrates, but they are opportunistic feeders, depending on the type of environment and season. Roller is an insectivore, feeding particularly on beetles and crickets. Seasonal changes in the relative proportions of plant and animal foods are usual, this latter being taken in higher proportion during the breeding season. These birds nest in trees, while Roller, Starling and House Sparrow nest in treeholes.

The next species equally inhabit broad-leaved, coniferous or mixed forests interrupted by scrubs, heath lands or grasslands. Some of them, e.g. Blackbird or Warbler (*Acrocephalus sp.*) may be found in wetlands as well. Goshawk and Booted Eagle principally hunt small to medium-sized birds and small mammals in the forest; Booted Eagle occasionally takes insects soaring over the open countryside. Tawny Owl (*Strix aluco*) in woodland mainly takes small rodents, birds and larger mammals, up to the size of young rabbit, but also earthworms and beetles as well. Woodcock, Great Spotted Woodpecker, Blackbird, Mistle Trush and Jay predominantly eat earthworms, insects and other invertebrates but seeds and fruits are also taken, especially in autumn and winter. In the diet of Woodpigeon (*Columba palumbus*) plant material dominates, complemented by insects.

The nest of these species is also made in woodland. Goshawk, Booted Eagle, Woodpigeon, Blackbird, Mistle Trush and Jay nest in the trees, among branches. Woodcock breeds on the ground, its nest being made in a shallow depression. Tawny Owl and Great Spotted Woodpecker make their nests in hollow trees, Tawny Owl sometimes in a hole in the ground, or among tree roots (Peterson *et al.* 1977; Cramp 1998).

Seasonality

Birds recognised from bone and eggshell remains found in archaeological contexts have largely been used indicating seasonality (Eastham 1997; Serjeantson 1998). However, one has to be aware of the flexibility of several species in seasonal presence, and of the birds' adaptation to recent environmental and climatic conditions, strongly defined by humans, when discussing seasonality with the aid of actualistic studies (Gál 2003).

A large number of birds (39 species = 93 per cent) identified from Ecsegfalva 23 have belonged, until the recent past, to the constant breeding avifauna of Hungary *(Fig. 19.3)*. This category is basically formed by resident species, present throughout the year, and by summer visitors that arrive for reproduction during the breeding season. Although Mallard and Crane recently have been met both in the passage seasons and during winters, based on ornithological evidence (Peterson *et al.* 1977; Nagy 2000) they used to breed in Hungary. Therefore, these birds are threatened as resident species (Mallard) and summer visitor (Crane) respectively, Crane's winter presence being ascribed due to anthropogenic intervention in the environment where this congregatory species may occur. Simi-

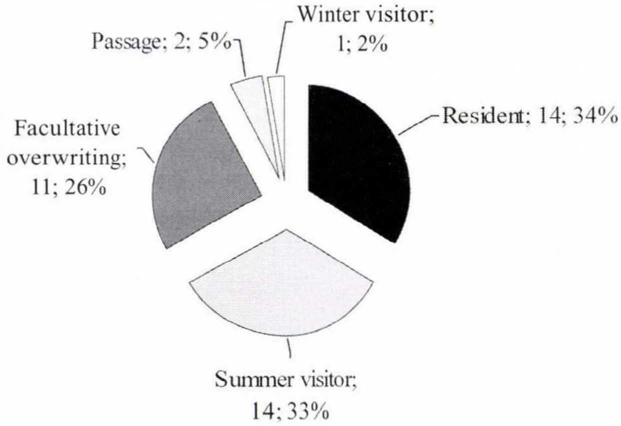

Fig. 19.3. Seasonal presence of bird species at Ecsegfalva 23 (n = 43)

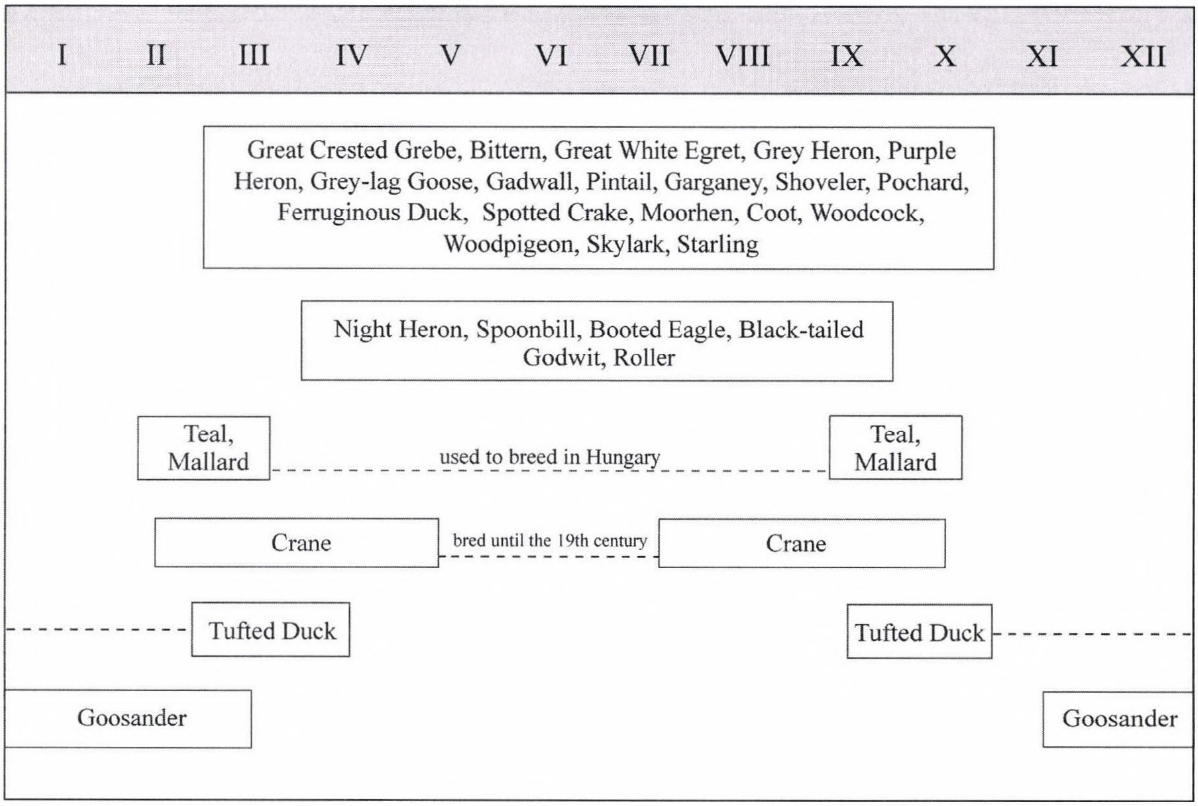

Fig. 19.4. Calendar illustrating the presence of different bird species in Hungary

larly, some ducks as Pintail, Garganey and Shoveler, or Black-tailed Godwit may be found either breeding or just passing over the country during migrations and flying further north for breeding or to southern areas for wintering. Recent data also confirm the breeding of this latter species in the Great Hungarian Plain near Dévaványa (Nagy 2000). In this study, another bird group named 'facultative over-wintering' was separated. Species (e.g. Bittern or Coot) that permanently breed in Hungary and may stay during the cold season when the winter is mild belong to this group.

There is no evidence for the breeding of two passage birds, Teal and Tufted Duck, in our region. Small flocks of the latter species sometimes over-winter in Hungary (Peterson *et al.* 1977). Only one winter visitor species was recognised in the assemblage from Ecsegfalva 23: the Goosander that breeds in Iceland, England and Scandinavia.

As presented here and summarised in *Fig. 19.4*, representing a calendar, the majority of migratory or partially migratory species arrive in Hungary in the early spring, during February and March, and leave the country in the late autumn, October–November. Strongly insectivorous birds like Spoonbill and Roller, or species (e.g. Night Heron, Booted Eagle and Black-tailed Godwit) feeding on other invertebrates and fish and amphibians arrive later in the breeding area. Grey-lag Goose is the single goose species that breeds in Hungary.

Bones of juvenile and/or subadult birds also relate to spring- or summer time. Medullary bone, serving as a calcium deposit, develops in females shortly before egg laying, and thus reliably indicates bird hunting in the breeding season (Serjeantson 1998). In Ecsegfalva 23, only two bones of chicks and three of subadult birds were found, while medullary bone formation was not recognised at all in this assemblage.

Taphonomic observations

In Trench 23A, only five bird bones were found in contexts 123, 125, 129 and 136, each of them belonging to different taxa: Starling, Ferruginous Duck, Purple Heron, Starling and Aves indet. Trench 23B held the majority of 267 bones in 57 contexts. Trench 23C also was poor in bird remains: six bones from four different contexts (525, 526, 527 and 531) furnished Mallard, Pochard/Tufted Duck, Woodpigeon and Aves indet. Two bones of indeterminable bird came from subadult. Basically, Trenches 23A and 23C are small, and 23A seems to be a peripheral part of the Neolithic settlement (see chapter 9).

Within Trench 23B the bird bones are not concentrated in any of the features and do not show an even distribution either. They are rather shared between numerous contexts in small numbers (1–10 remains). The highest numbers of bird bones were found in context 343 (19 bones), context 354 (28 bones), context 424 (17 bones), context 445 (29 bones) and context 464 (19 bones). All these contexts make up part of the main occupation level. Generally, Trench 23B is principally domestic and none of the bird bones came from special features (see chapter 9).

Owing to the careful excavation methods and sediment flotation, small finds such as shellfish, fish- and bird bones were recovered. The cautious collection and conservation of remains resulted in a bone assemblage representing a large scale of body parts, including even small bones such as vertebrae or phalanxes. *Fig. 19.5* was created to depict the distribution and conservation of every kind of bird bone found in Ecsegfalva 23.

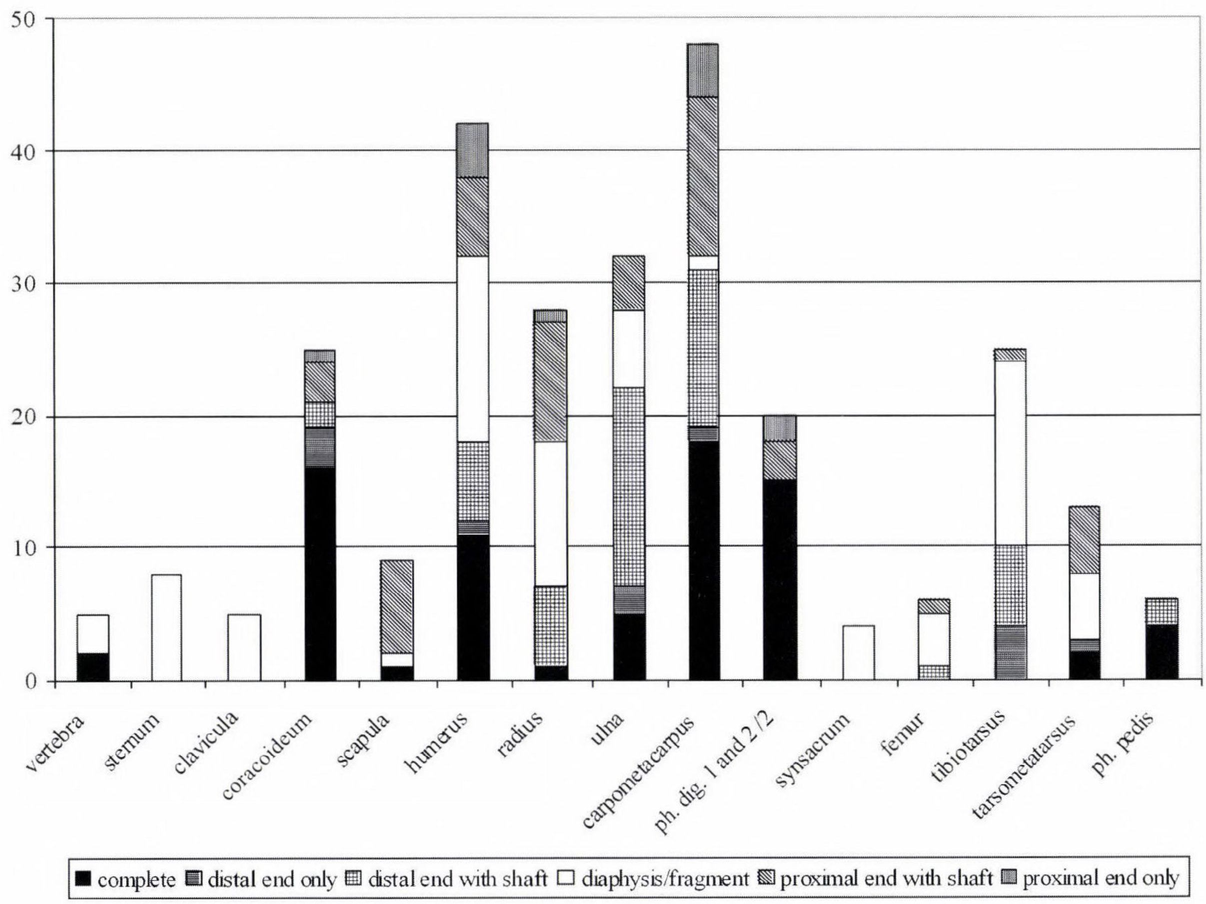

Fig. 19.5. Bone- and body part distribution in the avian assemblage of Ecsegfalva 23, Trenches A, B and C (n = 276)

The first impression when studying this picture is the complete absence of skulls. Other fragile body parts such as vertebrae, sternum, clavicula and synsacrum are noticeably under-represented by the five to eight pieces present in the entire deposit. The fragmentation of these remains, but of others as well, indicates their characteristic related to bird bones' particular structure and shape. All the aforementioned bones, excepting two vertebrae, were found in fragments. Short and relatively compact bones such as the coracoideum, and wing phalanges as well as toes were usually complete, only a small proportion of them having been fragmented. The scapula is delicate in birds and has only one epiphysis. This bone was found in small numbers and usually in a rather fragmentary condition.

Long bones, and especially skeletal elements of the wing, dominate the entire assemblage. Forty–two humeri, 28 radii, 32 ulnae and 48 carpometacarpi were found. Bones with relatively long and thin shafts, such as humeri, radii and ulnae, were more fragmented than shorter and stouter carpometacarpi that survived in larger numbers and better condition. Surprisingly few leg bones were found, almost all of them being scrappy. Femora were so fragmented that only two of them could be identified to species. Tibiotarsi, on the other hand, were outstandingly well represented among hind leg bones by 25 remains. None of these, however, were found complete, and the majority of fragments originated from diaphyses. No more than 13 complete and fragmentary tarsometatarsi were recovered *(Fig. 19.5).*

Finally, we have to mention that none of the bones bore traces resembling cut marks. Similarly, only few bones presented clear evidence of burning, such as the coracoideum of a Woodpigeon in context 301, the proximal end of a Gadwall coracoideum in context 343, a distal tibiotarsus fragment of a Mallard in context 357, the proximal coracoideum fragment of a duck (*Anas sp.* indet.) in context 407, and the diaphysis of femur of an Aves indeterminable in context 424. The distal coracoideum fragment of a Teal in context 301, and a distal ulna fragment of a Coot in context 431 were completely carbonated. All the enumerated pits belong to Trench 23B. Apart from these burnt fragments many bones present darkish marks, that also may be considered traces caused by fire.

Worked bird bones were not found in the bird assemblage from Ecsegfalva 23 at all, although different skeletal parts of mammals, especially those of *Ovis/Capra*, served as raw material for producing tools and other objects (Choyke, chapter 29).

Discussion

The group of birds identified from Ecsegfalva 23 site is very diverse. The majority of taxa are provided by middle- to large-sized waterfowls and wading birds. Additionally, medium-sized diurnal birds of prey such as Goshawk, Buzzard and Booted Eagle, an indeterminable harrier and one nocturnal predator, Tawny Owl were found. Middle- to large-sized terrestrial birds (e.g. Black Grouse, Crane or Great Bustard) also inhabited the surroundings of the locality just as forest species Woodcock, Woodpigeon, Great Spotted Woodpecker, and many passerines. The remains of these latter small birds may be the result of human hunting or trapping and of predators' activity as well.

Despite the various bird species recognised, the related NISP and MNI values are usually low, with one to two remains of one to two individuals found in the case of most species. Not only fowling, but generally hunting do not seem to have been very important in the economy of the inhabitants at this settlement as is indicated by the small ratio of game to domestic animals (Bartosiewicz, chapter 14). Mallard (33 remains of six birds), Woodpigeon (24 remains of four birds) and Ferruginous Duck (17 remains of three birds) presented a higher proportion of bird bones in the assemblage from the Ecsegfalva 23 site. In comparison, the most hunted bird at the nearby Körös culture settlement of Endrőd 119 was also Mallard, represented by 12 individuals, Great Bustard by eight individuals, Black Grouse by seven individuals, and Pochard and Crane by six individuals each (Bökönyi 1992a).

The majority of the recognised species are typically lowland birds, preferring wetland with shallow, permanent fresh water. The ecological characteristics of these birds indicate waters of medium to high biological productivity. Spotted Crake and Moorhen especially avoid oligotrophic and saline water. Species associated with wooded wetland overlap with aquatic species along the waters. The most needed vegetation for the recognised species was the reed bed that offered both cover and nesting site for many species. Grasses and agricultural crops also had to be present in the surroundings as is indicated by open field species such as Partridge, Great Bustard or Skylark. Among trees Willow, Poplar and other leafy forests were likely nearby. Detailed study of the vegetation of Ecsegfalva 23 is given in this volume by Bogaard *et al.* (chapter 23); Willis (chapter 6) and Molnár and Sümegi (chapter 4).

The great number of resident and summer visitor species indicate spring to autumn bird hunting by the inhabitants. Many locally breeding birds may have arrived in early spring such as in February and March and may have left in late autumn, around October–November *(Fig. 19.4)* Springtime fowling is further emphasised by the remains of juvenile and subadult birds. The human hunting activity probably was more important in this period of year when floodings are still common in the Great Hungarian Plain (Molnár and Sümegi, chapter 4). The large amount of young pike (*Esox*) bones possibly indicates a similar event around the settlement (Bartosiewicz, chapter 20). Some passage species (e.g. Teal, Mallard or Crane) could breed or only over pass in the migration periods. Autumn shellfish collecting also can also be suggested as well as spring gathering (Sümegi, chapter 21). Based on the single winter visitor bird species, Goosander, we can not state winter bird hunting. The large number of resident and possible over-wintering species may have been hunted during the cold season as well. Data on other animal remains, however, better seem to indicate the permanent occupation of the site. Skeletochronological analysis of sheep and goat remains offered evidence of cold season death for several individuals. Within the late fall to spring period the majority of the animals died during the winter and early spring (Pike-Tay, chapter 16). Foetal remains of lambs confirm this tendency (Bartosiewicz, chapter 14).

In addition to the high number of bird remains and rich list of species, another important feature of the bird bone assemblage from Ecsegfalva 23 is the differential distribution of avian skeletal remains. The entire surface of Trench 23B that yielded the great majority of bones seems to have been domestic, and no special contexts could be connected with avian remains. Therefore, all bones are interpreted here as a complete and single assemblage associated with people's interest in birds. We may also assume that the majority of these bird bones have been deposited through human action (e.g. fowling, capturing, and so on) and only passerine remains may be attributed alternatively to predators' activity or scavenging.

The total absence of skull remains and the few leg bones in our material would indicate the removal of the head and legs off-site, where hunting took place, and the transport of only the fleshy parts of the body to the site. The small number of femora holding a considerable amount of tasty meat may be related to the fragile structure and thereupon taphonomic loss of this body part. It is interesting to notice that three of the four diurnal predators are represented by one single tarsometatarsus each. This long bone, the most distal one in the hind limb, is strong in predators and has an important role when these birds are hunting. It may have been, therefore, mechanically more resistant to taphonomic agents, but also may have had special meaning for ancient people such as power or courage. Ethnographic examples of ritually displaying the severed head and feet of bearded vulture (*Gypaetus barbatus*) are known from Mongolia (Benkő 1998, 125).

Wing bones formed by humeri, radii, ulnae, carpometacarpi and anterior phalanges make up 61.6 per cent (170 of 276 remains) of the bird bone material found at Ecsegfalva 23. The dominance of wing skeleton parts over the leg bones was verified by using a Chi^2 test, which confirmed that there were significantly more wing- than leg elements present for every kind of bird ($\chi^2 = 335.97$, df = 7, $p < 0,000$) (Williams 1979). This result means that the distribution of elements is not uniform and some sort of heterogeneity existed in the accumulation caused either by human selection or taphonomic loss.

The phenomenon that wing bones far outnumber other skeletal parts in avifaunal assemblages from many sites representing various time periods has been discussed recently by Bovy (2002). This study reviews the possible reasons and agents for the abundance of wings. One of the hypothetical explanations would be cultural. In this case several interpretations have been put forward by different scholars. One of them would be the differential removal, discard, transport and consumption of body parts. This idea was explained when trying to interpret the lack of cranium and the small number of leg bones at Ecsegfalva 23. The selective accumulation of only meaty parts from birds, however, is unlikely as is suggested by the poor representation of sterna, bones of the pectoral girdle and femora. Nevertheless, these bones are the most fragile and therefore highly exposed to taphonomic loss as well. The consistent pattern of disarticulation when the ends of humeri and ulnae of gulls were regularly broken in Greenland (Gotfredsen 1997) could not be detected in our case.

Another idea for the abundance of wing bones would be the curation and use of wings and/or their feathers. Wings and especially the tips of wings may have been used as brooms or feather dusters as they are still used in rural areas of Eastern Europe. It is also still common that men (especially hunters) decorate their hats with colourful feathers or wing tips of this kind. The beauty of colourful quills in the wing of a Blue Roller moved the artistic imagination of Albrecht Dürer in 1512 *(Fig. 19.6)*. A coracoideum of this very decorative bird also came to light from context 464 in Ecsegfalva 23B.

Other evidence of the possibly cultic use of wings has recently been reported from Çatal Höyük, where articulated wing bones of a Crane were found together with a complete cattle horn core, goat horn cores, a complete dog head and a stone macehead. Relying on other cultural background, namely the wall paintings depicting vultures with human legs and two facing cranes, the authors suggest that the perforated crane wing was used in 'crane dancing' linked with rebirth, the beginning of new life and marriage (Russell and McGowan 2003).

Wing bones from middle-sized and large-bodied birds are particularly suitable for making special objects such as flutes and fine tubes. There is archaeological evidence for this idea (Wijngaarden-Bakker 1997) but it is not the case for Ecsegfalva where no manufactured bird bones were found (Choyke, chapter 29). Bovy (2002) collected examples and references for the use of wing bones and feathers in weaving. Although weaving is known in the Middle East as far back as the Early

Fig. 19.6. The wing of a Blue Roller drawn by Albrecht Dürer in 1512 (by permission of the Albertina Museum, Vienna)

Neolithic, and we cannot fully exclude its knowledge and practice in the Great Hungarian Plain, there is no evidence for this kind of human activity from Ecsegfalva 23.

A further explanation for the great number of wing bones would be the differential post-depositional preservation that is mainly connected with bone density (Bovy 2002). In this relation compact bones (e.g. carpometacarpus or tarsometatarsus) are more likely to survive than pneumatic bones with hollows such as the humerus or femur. We have to take into consideration, however, that pneumatisation and generally bone strengths vary greatly among bird taxa and bone types, even within a single element (Higgins 1999). Therefore the definition of a generally valid theory in this subject seems almost impossible.

Bone density and pre-depositional preservation are often connected to the taphonomic loss caused by carnivorous and omnivorous mammals such as dogs and pigs. In case of the bone assemblage from Ecsegfalva 23, we may observe that small and fragile skeletal parts of every class of the recognised animals (fish, bird, etc.) were found in noticeable proportions. Gnawing marks were not recognised on the bird bones, and only 22 such traces were found on thousands of mammalian bones. Four of these were caused by rodents. Dogs and pigs generally were few in this settlement (Bartosiewicz, chapter 14).

The analyses richly supported by data from many sites and periods, and discussed by Bovy (2002), failed to provide empirical support for the bone density explanation for the abundance of wing bones in North American sites. At Ecsegfalva 23, carpometacarpi were the richest bone type with 48 remains (17.4 per cent of the entire assemblage). Together with the connected anterior phalanges (20 remains), they make up 24.6 per cent of the bird bone accumulation. In case of the best represented Mallard, 66.6 per cent of the bones (22 of 33) belong to the whole wing, while 45.4 per cent (15 of 33 remains) to the wing tip. Woodpigeon is characterised almost entirely by wing bones (95.8 per cent, 23 bones of 24), the only exception being a scapula. Distal wing bones make up 73.9 per cent of Woodpigeon remains. The remains of Ferruginous Duck rather belong to the total wing (76.5 per cent, 13 remains of 17), than to its distal part (3 bones = 17.6 per cent). In the case of Coot, no wing tips were found at all but the other bones of wing skeleton form 50 per cent (7 of 14) of the remains. In addition, Grey Heron, Purple Heron and Grey-lag Goose mainly presented wing tips (3 of 4, 4 of 8, and 3 of 4 bones respectively). Also, only carpometacarpi or anterior phalanxes represented many other large species, such as Great White Egret, Spoonbill, Great Bustard and Tawny Owl. Among passerines, Starling is outstanding by its six remains that all are wing bones (4 ulnae and 2 carpometacarpi). In the present state of our data and knowledge, it seems that wings of certain birds were used in some way and discarded thereafter.

Conclusions

Due to the careful collection and curation of the bird bone remains the deposit of Ecsegfalva 23 yielded the greatest number of identifiable bones from the prehistoric sites in Hungary. The recognised taxa have enriched the Neolithic avifauna of Hungary by 22 new species and the Neolithic bird fauna of the Carpathian Basin by 17 species.

Despite the species abundance, the related NISP and MNI values suggest that birds played only a secondary role in the provision of the site's inhabitants, and they served as a seasonal source of meat, eggs and probably of feathers. The identified species indicate early spring to late autumn inhabitation of the site, but the presence of the numerous resident birds, possible over-wintering species and a winter visitor, Goosander, do not exclude human activity during the cold season either.

The ecological characteristics of species hint to wetland with shallow fresh water, periodically deep in some places. The settlement must have been surrounded by dense reed beds and wooded wetland with scattered shrubs and trees, and probably thicker forest in the area. Open field species suggest a certain extent of grassy terrain and crops as well.

The bird bone assemblage does not indicate any system in bird hunting, which was probably an opportunistic and mainly seasonal occupation. There is no evidence for systematic butchering and cooking, or for bird bone working either. Mostly bones of adult birds, and only few juveniles and subadults were found, that would suggest a focus on the mass of meat and other body parts of the middle- and large sized species. Passerines may have been hunted by humans and other predators, or resulted from natural deposition. The differential representation of skeletal elements suggests the selective use of body parts. Taphonomic loss, bone density and wing curation could cause the dominance of wing bones in the assemblage of Ecsegfalva 23.

Acknowledgements

I am grateful to Alasdair Whittle for the invitation to work on the bird remains and to take part in the Ecsegfalva Workshop held at the University of Cardiff in May 2003. I thank Anne Birgitte Gotfredsen and Mihály Gasparik for the access to the recent bird bone collections of the Zoological Museum of University of Copenhagen and Hungarian Natural History Museum, respectively. László Bartosiewicz is thanked for the accession of references and for his comments on the manuscript. The author's research was partially funded by a Domus Hungarica Junior Fellowship (2002) and by EC 5 – Access to Research Infrastructure action of the Improving Human Potential Programme (COBICE, 2002). Erika Gál currently is being granted by the Bolyai János Fellowship and OTKA project F048818.

Appendix

Appendix Table 19.1. Sizes of the avian remains, basically following von den Driesch (1976)
* Dic in scapula, ** Bb and *** BF in coracoid, SmII = Smallest breadth of the os metacarpale II in carpometacarpus

Species	Bone	Sizes							
		GL	Lm	Bp*	Dp	SC	SmII	Bd**	Dd***
Botaurus stellaris	carpometacarpus						3.7	7.5	5.4
Egretta alba	carpometacarpus			13.5	6.5				
Egretta alba	carpometacarpus						2.5	7.4	4.9
Ardea cinerea	carpometacarpus			16.5			5.6		
Ardea cinerea	carpometacarpus			17.1			4.6		
Ardea cinerea	carpometacarpus						4.3	10.5	7.7
Ardea cinerea	phalanx distal	26.4		3.7					
Ardea purpurea	radius			6.5	5.5	3.8			
Ardea purpurea	ulna					5.0		10.3	9.1
Ardea purpurea	carpometacarpus			13.7			3.9		
Ardea purpurea	carpometacarpus						3.5	7.6	4.8
Ardea purpurea	phalanx anterior 1 digiti II	27.7		6.0	5.9				3.5
Platalea leucorodia	carpometacarpus	75.0	71.8	15.5			4.5		7.5
Platalea leucorodia	phalanx anterior 1 digiti II	35.8		7.6	6.2	10.6		7.6	4.6

Species	Bone	Sizes							
		GL	Lm	Bp*	Dp	SC	Smll	Bd**	Dd***
Anas cf. strepera	coracoideum	47.4	42.7			5.2			19.3
Anas cf. strepera	coracoideum					4.6			16.6
Anas cf. strepera	coracoideum					5.3			19.0
Anas cf. strepera	scapula			9.9		4.3			
Anas cf. strepera	carpometacarpus	51.0	47.5	12.0			4.2	7.3	4.8
Anas cf. strepera	carpometacarpus			12.5	5.6		4.0		
Anas crecca	scapula			6.9		2.6			
Anas crecca	scapula			8.1		2.7			
Anas crecca	ulna			6.7	7.9	3.6			
Anas crecca	ulna					3.2		6.6	5.4
Anas crecca	carpometacarpus	36.5	33.9	8.6			2.8	4.6	3.2
Anas platyrhynchos	coracoideum	55.2	51.1			6.0			20.3
Anas platyrhynchos	scapula			12.9		4.7			
Anas platyrhynchos	scapula			13.2		4.8			
Anas platyrhynchos	humerus					6.6		11.5	
Anas platyrhynchos	humerus					6.9		14.0	
Anas platyrhynchos	ulna					5.1		10.6	7.9
Anas platyrhynchos	ulna					5.6		10.6	8.7
Anas platyrhynchos	ulna							10.3	8.6
Anas platyrhynchos	carpometacarpus	55.0					4.2	6.6	5.0
Anas platyrhynchos	carpometacarpus	55.7	51.8	12.8			4.4	7.3	4.9
Anas platyrhynchos	carpometacarpus	56.1				8.1	4.5	7.2	5.2
Anas platyrhynchos	carpometacarpus	59.6	55.4	13.9			5.4		
Anas platyrhynchos	carpometacarpus	60.4	56.0	13.7			4.6	8.1	5.4
Anas platyrhynchos	carpometacarpus	60.6	56.2	14.2			5.2	7.7	5.7
Anas platyrhynchos	carpometacarpus	61.0	57.1	13.8			4.6	8.6	5.8
Anas platyrhynchos	carpometacarpus			13.1	6.5				
Anas platyrhynchos	carpometacarpus				5.8		3.8		
Anas platyrhynchos	carpometacarpus						4.3	7.7	5.6
Anas platyrhynchos	carpometacarpus						4.0	7.0	4.9
Anas platyrhynchos	carpometacarpus							6.9	4.8
Anas platyrhynchos	phalanx anterior 1 digiti II	21.9		6.0	5.1	7.3		6.2	4.1
Anas platyrhynchos	phalanx anterior 1 digiti II	23.9		6.3	4.8	7.4		6.3	3.7
Anas platyrhynchos	tibiotarsus					4.0		8.5	8.0
Anas platyrhynchos	tarsometatarsus	44.8		9.7	9.1	4.4		9.6	7.1
Anas platyrhynchos	tarsometatarsus			9.7		5.5			
Anas cf. acuta	coracoideum					4.5		16.9	
Anas cf. acuta	radius			5.1	4.2				
Anas cf. acuta	carpometacarpus	53.4	50.1	12.1			4.1	6.9	4.8
Anas querquedula	ulna			6.9	8.6				
Anas querquedula	ulna			7.2	3.4	3.4			
Anas querquedula	ulna					3.5		6.3	5.9
Anas querquedula	carpometacarpus	42.6	39.5	9.9			3.3	5.8	3.9
Aythya ferina	humerus					5.7		12.2	7.5

Appendix Table 19.I. Continued

Species	Bone	Sizes							
		GL	Lm	Bp*	Dp	SC	Smll	Bd**	Dd***
Aythya ferina	ulna			7.9		4.0		8.4	6.8
Aythya ferina	carpometacarpus						3.5	5.8	3.9
Aythya fuligula	humerus			17.2		5.2			
Aythya fuligula	ulna							8.4	7.0
Aythya nyroca	coracoideum		39.0			3.9			
Aythya nyroca	humerus	72.0		16.4		4.6			
Aythya nyroca	humerus			15.5		5.1			
Aythya nyroca	humerus					4.6		8.4	5.5
Aythya nyroca	radius			4.1	3.3	2.2			
Aythya nyroca	radius					2.1		4.4	2.7
Aythya sp.	radius			4.2	3.9	2.5			
Aythya nyroca	ulna	61.6		6.7	8.7	3.9			
Aythya nyroca	ulna					3.2		6.5	5.7
Aythya nyroca	ulna							8.4	6.9
Aythya nyroca	carpometacarpus	37.5					2.6	4.9	3.3
Aythya nyroca	carpometacarpus	38.2	35.7	8.9			3.0	5.1	3.6
Aythya nyroca	tibiotarsus					3.1		6.7	
Aythya nyroca	tarsometatarsus			7.0		4.1			
Mergus cf. merganser	tibiotarsus					4.9		9.7	9.7
Buteo buteo	tarsometatarsus			11.8	9.3				
Hieraeetus pennatus	tarsometatarsus			10.9					
Tetrao tetrix (male)	carpometacarpus	47.7	41.7	13.8		9.5	4.6	9.8	5.6
Tetrao tetrix (male)	femur			16.2	10.5	6.7			
Porzana porzana	humerus					2.4		5.1	3.1
Fulica atra	humerus					4.7		9.3	5.3
Fulica atra	radius	59.0		2.9	3.4	2.1		4.2	2.6
Fulica atra	radius			3.9	3.2	2.3			
Fulica atra	radius					2.2		4.4	2.9
Fulica atra	ulna	63.1		6.8	7.8	3.5		6.1	5.4
Fulica atra	ulna					3.2		5.6	5.3
Fulica atra	femur					4.0		9.6	7.4
Fulica atra	tibiotarsus					4.0		8.5	7.9
Grus grus	tibiotarsus					10.5		23.0	21.7
Otis tarda (male)	phalanx anterior 1 digiti II	52.4		12.5	10.0	14.6		12.8	7.5
Columba palumbus	humerus			16.6					
Columba palumbus	radius			5.0	4.1	2.3			
Columba palumbus	radius					2.4		5.1	3.4
Columba palumbus	radius					2.4		5.7	3.6
Columba palumbus	carpometacarpus	35.5	32.7	10.5			2.8	7.1	4.4
Columba palumbus	carpometacarpus	37.3				8.0	2.8	6.8	4.3
Columba palumbus	carpometacarpus	38.3	36.3	11.1			3.0	7.4	
Columba palumbus	carpometacarpus			10.3	4.9		2.7		
Columba palumbus	carpometacarpus			10.9	5.5				

Appendix Table 19.I. Continued

Species	Bone	Sizes							
		GL	Lm	Bp*	Dp	SC	SmII	Bd**	Dd***
Columba palumbus	carpometacarpus			10.9	5.0				
Columba palumbus	carpometacarpus			11.0	6.5		2.8		
Columba palumbus	carpometacarpus						2.8	9.2	4.3
Columba palumbus	phalanx anterior 1 digiti II	18.4				7.6			
Columba palumbus	phalanx anterior 1 digiti II	19.6		7.0	4.0	8.4		7.8	
Columba palumbus	phalanx anterior 1 digiti II	20.1		6.6	4.0	7.5		7.5	4.1
Columba palumbus	phalanx anterior 1 digiti II	20.4				8.3		7.1	4.1
Columba palumbus	phalanx anterior 1 digiti II	21.2			4.1	8.3		7.4	4.1
Columba palumbus	phalanx anterior 1 digiti II			6.0	3.9				
Columba palumbus	phalanx anterior 1 digiti II			6.4	3.9				
Columba palumbus	phalanx anterior 2 digiti II			4.3					
Strix aluco	phalanx anterior 1 digiti II	18.9		4.6	3.9	6.5		5.1	3.8
Coracias garrulus	coracoideum	ap. 30	28.4			2.2			8.1
Dendrocopus major	ulna					2.3		4.5	3.6
Alauda arvensis	ulna					1.9		3.5	2.5
Turdus viscivourus	tarsometatarsus	33.0		4.7	4.6	1.7		3.8	2.1
Garrulus glandarius	ulna					2.9		5.8	4.1
Pica pica	tibiotarsus							5.7	5.5
Corvus cf. corone	ulna					5.8		10.4	7.5
Sturnus vulgaris	humerus	28.8		9.1		2.9		7.4	3.5
Sturnus vulgaris	humerus			8.2		2.5			3.2
Sturnus vulgaris	humerus			8.8		2.8			
Sturnus vulgaris	humerus							6.9	3.4
Sturnus vulgaris	ulna					2.0		4.0	2.9
Sturnus vulgaris	ulna					2.1		4.1	2.8
Passer domesticus	humerus	18.8		6.0		1.8		4.9	2.3
Passer domesticus	humerus			6.1		1.7			

Chapter 20

FISH REMAINS

László Bartosiewicz

Introduction

The exploitation of aquatic resources seems to have been a characteristic form of subsistence at all major Körös culture sites. Fish, as well as several species of riverine mussel, were readily available sources of animal protein, given the location of these settlements in floodplain and marshland habitats.

It has been customary to treat fish remains together with those of 'wild animals' in the archaeozoological literature. However, the importance of fish relative to that of terrestrial animals, whether wild or domestic, is difficult to measure owing to fundamental differences between the anatomy and taphonomic properties of their skeletons. Times and modes of preying upon various classes of animals also varied. It may thus be presumed that aquatic animals filled a special niche in Early Neolithic subsistence.

The presence of fish remains, on the other hand, also characterises the quality of alluvial environments in and of itself, as well as the attitudes of prehistoric people to these habitats. Moreover, the evidence of certain species may also be treated, at least in a stochastic sense, as a potential indicator of seasonality.

Material

The contribution of fish to the diet is difficult to compare between sites in Hungary, since water-sieving was usually not carried out at most previous excavations, making the quantitative evaluation of fish remains virtually impossible. Using hand-collection only, bone fragments smaller than 18 mm have a good chance of never being spotted during excavation (Bartosiewicz 1988). The recovery of small fish bone is especially prone to this type of bias. The water-sieved material from Ecsegfalva 23, however, offered a large and varied assemblage of identifiable fish bones (in addition to masses of small fragments that, unfortunately, displayed no diagnostic morphological features).

It is noteworthy that the proportion of 5952 identifiable mammalian remains (number of identifiable specimens = NISP) to those of 18,184 fish remains was 0.279 in the water-sieved assemblage of Ecsegfalva 23, in sharp contrast to the 37.8 value calculated in the hand-collected Körös culture assemblage of Endrőd 119 (mammals NISP = 22,368, Bökönyi 1992a, 197; fish NISP = 592, Takács 1992, 301). Given the extreme similarity between the more reliably represented mammalian components of these two Early Neolithic assemblages, it is highly unlikely that fish exploitation in a very similar environment would have been so dramatically different.

The overall distribution of fish bone material in the three trenches opened at Ecsegfalva 23, as well as the relation of NISP to weight are shown in *Table 20.1.* (No fish remains were recovered from Trench 18A.)

Table 20.1. Summary of fish remains from Ecsegfalva 23

Area	23A	23B	23C	Total
Fish remains				
Total NISP	**26**	**17,703**	**455**	**18,184**
Total weight, g	7.2	1020.6	39.4	1067.2
Mean weight, g	0.3	0.1	0.1	0.1

The taxonomic/anatomical composition of the material is detailed by excavation trenches in *Appendix Tables 20.I–III.* The differences between skeletal elements available from various species are largely related to the anatomy of individual fish families, i.e. the differential preservation and identifiability of their bones. Therefore, beyond the necessity of documenting the anatomical distribution of surviving elements, the representation of various fish is most realistically seen in terms of presence/absence. Hence, the evaluation of fish remains from the site of Ecsegfalva 23 revolves much around taphonomy and the intricacies of seasonal interpretation, rather than the quantification of the undoubtedly valuable animal protein provided by these animals.

Fish bone measurements listed in *Appendix Table 20.V* were taken following the standards published by Morales and Rosenlund (1979).

Taphonomy

Thanks to favourable soil properties, the overall preservation of fish remains was better than that of the relatively fragmented mammalian assemblage. In spite of this, a number of taphonomic factors had to be taken into consideration. Taphonomy, a concept first introduced in palaeontology (Efremov 1940), has been aimed at understanding *post mortem* changes in animal remains prior to excavation, thereby helping the critical assessment of such data available for the reconstruction of a living animal community (*biocoenosis*) from remains of a 'dead community' (*thanatocoenosis*), as defined by Wasmund (1926) who first developed these concepts in aquatic ecology.

The taphonomic interpretation of archaeological assemblages, however, is further complicated by the fact, that thanatocoenoses in culture-bearing layers have usually been deposited through human action. These ancient, 'primary' human effects are themselves of utmost interest to the archaeologist from a culture historical point of view. They include:

1. *The procurement of fish*: ancient human preferences and/or technical limitations of prehistoric fishing may distort the reconstruction of alluvial environments.
2. *Age and size criteria*: in addition to preferring fish species of certain sizes, these parameters may have had an influence on which individuals were targeted; both age-related density and size-determined relative surface influence bone preservation and recovery as well.
3. *Differential deposition*: fish of various sizes were dismembered and transported, often selectively, and scavengers' access also varied as result of disposal in protected features versus open air bone scatters.

Recognising and understanding any of these three aspects of taphonomic loss offer information on the way prehistoric people caught and treated fish. In addition, a number of post-depositional, natural effects including soil acidity destroy fish bone owing to the large relative surface of small size finds. In the case of fish (especially fatty species such as carp), the possibility of autolysis by fatty acids of the decaying body itself has also been discussed (Prummel 1986, 115–16; Mézes and Bartosiewicz 1994). Finally, exposure to and transport by water must also be reckoned with.

The remains of small fish (especially Cyprinids, an overwhelmingly dominant component of the Ecsegfalva 23 assemblage) fall victim not only to primary taphonomic effects such as digestion by humans and animals (Jones 1986, 54), but are also particularly sensitive to the precision of recovery. From this point of view, it is of extreme importance that water sieved samples were available from all three trenches (A, B and C) at Ecsegfalva 23.

Interspecific differences

Attempts at reconstructing the role of fish in prehistoric subsistence are not only influenced by taphonomic processes but also by skeletal differences between various fish species. The characteristic morphology of species as well as the number of skeletal elements in fish vary between wide margins. For example, the number of vertebrae is 36–37 in carp, 61–64 in pike and 71–75 in catfish (Takács 1992, 305, table 4). In the case of the best represented carp family (Cyprinidae, c. 80% of identifiable fragments at Ecsegfalva 23), enamel-covered pharyngeal teeth on the fifth pair of ceratobranchials tend to be well preserved and are, more or less, the only elements that permit unambiguous species-level identification. Vertebrae, on the other hand, of almost identical morphology in many Cyprinid species, have a distinct look in pike and catfish, thus providing precise species identification in great numbers. Consequently, NISP values offer a distorted representation of various fish species, compounding the aforementioned problems caused by differential preservation. Calculating the minimum numbers of individuals (MNI) is as contradictory in fish bone assemblages as with mammals and was thus avoided in this study.

Results

The settlement is located within the loop of an ancient meander. Additional fishing in the nearby river as well as its floodplain must have provided a readily available source of animal protein for the inhabitants of the Ecsegfalva 23 settlement in most parts of the year. The majority of identifiable fish remains represent the carp family and common carp in particular. The remains of pike are of similarly great interest. Sporadically occurring remains of other species contribute additional details to this picture.

Taxonomic descriptions

Sterlet (*Acipenser ruthenus* Linné 1758) a non-anadromous member of the sturgeon family (Acipenseridae) was represented by only a few remains in the assemblage. Sterlets may attain a total length of 1–1.2 m, weighing at most 15–16 kg, a relatively small size, when compared to other sturgeon species seasonally migrating between the upper reaches of the Danube and Tisza rivers and the Black Sea. This species requires at least 3.0–3.5 mg/l dissolved oxygen content in the water (Pénzes and Tölg 1977, 327). It was thus possibly caught in the nearby Berettyó river (some 2 km north of the settlement), or was a rare straggler in the stagnant, marshy waters around the site. Active river channels in the plain region (*metapotamon*, Harka 1993, 87) are characterised by a relatively slow current (< 0.5 m/p) which at 25°C guarantees a 2.5–3.0 mg/l dissolved oxygen content (Bartosiewicz and Bonsall 2004). The rare occurrence of sterlet remains points to the possibility of off-site fishing.

Pike (*Esox lucius* Linné 1758) is probably the most active carnivorous fish in the waters of Hungary, usually preying upon small, widely available Cyprinid fish. The total length of adult pike may be as much as 1.5 m, with large individuals weighing 25 kg. Pike remains occur commonly in the Ecsegfalva 23 material, although a remarkably large number of identifiable remains originate from small, subadult and even juvenile individuals. This phenomenon is especially interesting since the otherwise almost ubiquitous pike relies heavily on visual stimuli in hunting

Table 20.2. Body size variability in Cyprinid fish identified at Ecsegfalva 23. Listed in the decreasing order of total length (after Bartosiewicz and Bonsall 2004, 261, Table 3)

Species		Total length, m	Live weight, kg
Carp	*Cyprinus carpio* L. 1758	max. 1.00	30.00
Barbel	*Barbus barbus* L. 1758	0.70–0.80	4.00–5.00
Orfe	*Leuciscus idus* L. 1758	0.35–0.70	0.50–1.50
Tench	*Tinca tinca* L. 1758	0.25–0.60	0.30–2.50
Vimba	*Vimba vimba* L. 1758	0.25–0.30	0.20–0.40
Crucian carp	*Carassius carassius* L. 1758	0.20–0.50	0.30–0.50
Bream	*Abramis brama* L. 1758	0.15–0.40	0.20–0.40
Roach	*Rutilus rutilus* L. 1758	0.10–0.35	0.05–0.20

(Johannes Lepiksaar, *pers. comm.*), which would be evidently easier in clear, fast flowing waters. The spawning of pike takes place early, in February–March, at 7–10°C water temperature, when the dissolved oxygen content is still relatively high. By April to June, as Cyprinids are spawning, young pike (first consuming plankton and water insects) turn to eating the offspring of various carpfish (Berinkey 1966, 35). The marshy, alluvial habitats around the Ecsegfalva 23 settlement, abundant in small Cyprinids, seems to have been optimal for this feasting scenario.

The carp family (Cyprinidae) is represented by some 200, largely fresh water genera worldwide. Twenty of these are native to waters in Hungary, eight of which could be identified in the Ecsegfalva 23 assemblage. This relative richness is especially welcome, since identification is mostly limited to the pharyngeal teeth and a few robust skeletal elements of these osteologically very similar fish. The chances of species identifications were greatly enhanced by the high rate of recovery of these small elements, thanks to the use of water sieving.

Carp, represented by the greatest numbers of bones among the eight species identified, is by far the largest Cyprinid, followed by rarely occurring barbel at this site. The rest vary between 0.1–0.7 m in total length. Depending on specific shape, the live weight of small Cyprinids is similarly variable, as shown in *Table 20.2.*

Data listed in this table show that aside from the largest species, small Cyprinids (including juvenile carp) must have been largely interchangeable in terms of their dietary contribution. Although distinctions may have been made by taste or culinary tradition by prehistoric people, it is mostly the different habitat requirements and spawning schedules of various Cyprinid fish that would make accurate species identification meaningful. Various species in the carp family will be discussed here in their order of relative importance, assessed on the basis of their NISP in the Ecsegfalva 23 assemblage.

Carp (*Cyprinus carpio* Linné 1758) has been the dominant fish species exploited for meat throughout Hungarian history. Its wild ancestor, represented by these prehistoric remains, is considered genetically extinct owing to cross-breeding with numerous domestic forms since the Middle Ages. Carp is not only the largest, but also the most commonly encountered member of the Cyprinidae family in the Ecsegfalva 23 assemblage. This is not surprising, since it is a typical fish of warm, stagnant or slowly-flowing waters. Studies of record-size modern feral carp in Hungary have shown that they mostly originated from warm lakes and stagnant oxbows, with only a relatively small contribution of large carps from the major Danube and Tisza rivers (Bartosiewicz *et al.* 1994, 57, fig. 2). These record animals, on average, weighed c. 13 kg.

At the time of spawning, carp move into shallow waters close to shore, characterised by dense aquatic vegetation. During this time, they also tend to jump high in the water, thereby bringing themselves inadvertently to the attention of predators, both animal and human.

Tench (*Tinca tinca* Linné 1758), the most characteristic small Cyprinid species identified at Ecsegfalva 23, represents the lower end of the dissolved oxygen requirement scale (0.7 mg/l) among the fish found at the settlement. As a result, it is also resistant to high water temperatures during the summer that are in an inverse relation with dissolved oxygen content. Tench is a typical fish of stagnant, muddy waters, rarely occurring in active rivers. The relatively high contribution of its remains to the assemblage indicates the importance of floodplain/marshland fishing in the immediate proximity of the settlement. Parameters of these stagnant waters must have corresponded to the lowest, slow-flowing sections of rivers (*hipopotamon*; < 2.5 mg/l dissolved oxygen; Bartosiewicz and Bonsall 2004).

Roach (*Rutilus rutilus* Linné 1758) is a commonly occurring small Cyprinid across temperate Europe, found in great numbers in shallow waters at the time of spawning. Otherwise, this species prefers deeper waters with scantier vegetation than many of the other Cyprinids identified in the Ecsegfalva 23 material (Pintér 1989, 58). This species is considered useless by modern anglers owing to its small size, but serves as an important link in the foodchain for carnivorous fish (Berinkey 1966, 40) such as pike.

Barbel (*Barbus barbus* Linné 1758), the indicator species of the submontane *epipotamon* river zones (Harka 1993, 87), represents alluvial habitats more upstream with faster current and better supplies of dissolved oxygen than that of the aquatic habitats around Ecsegfalva 23. Of all Cyprinid fish, it is closest to sterlet and pikeperch in this regard, whose ecological requirements least fit the hydrological environment around the settlement.

Vimba (*Vimba vimba* Linné 1758) is a rarely occurring, very adaptable anadromous Cyprinid, seldom caught in Hungary today (Berinkey 1966, 85). Its sporadic remains in the Ecsegfalva 23 assemblage are a sign of the dynamism characteristic of alluvial faunas. Its spawning takes place in waters shallower than 1 m. Owing to its small body size and rare occurrence, this species must have been of negligible importance in the diet.

Orfe (*Leuciscus idus* Linné 1758) is a relatively large-bodied small Cyprinid, popular among anglers today. Although this fish, preferring cooler waters, may be caught at greater depths in rivers and lakes throughout the year, during its early summer spawning it masses near the banks in waters no deeper than 50–70 cm (Berinkey 1966, 46).

Bream (*Abramis brama* Linné 1758) is considered the pilot species of alluvial habitats in the plain (*metapotamon*, Harka 1993, 87), previously identified with the active Holocene channel of the Berettyó river. In contrast to sterlet and pikeperch (to be discussed below), however, it would have also tolerated slower flowing waters, poorer in dissolved oxygen.

Crucian carp (*Carassius carassius* Linné 1758), although only represented by a few remains in the Ecsegfalva 23 assemblage, is almost as characteristic of slow flowing and stagnant waters as tench. Owing to its low requirement of oxygen, it is tolerant of warmth and thus occurs commonly in shallow waters with dense vegetation. Today, crucian carp, whose populations in Hungary consist mainly of hand-size individuals, is a successful competitor to carp in muddy, neglected fish ponds. It is also an important prey species for pike (Pintér 1989, 107).

Catfish (*Silurus glanis* Linné 1758; also sheathfish or wels) is the largest fish inhabiting the waters of Hungary, aside from the anadromous sturgeons. Large specimens reach 2–2.5 m and 120–150 kg here (Pintér 1989, 135). They may reach sizes of up to 5 m and 330 kg in the Dniepr (Curry-Lindahl 1985, 259). Catfish are indeed ferocious carnivores with fearful reputations. One of their vernacular synonyms, *parasztfaló*, literally means 'peasant gobbler' in Hungarian (Gozmány 1979, 957).

Although the remarkable adaptability of catfish makes this species a flexible carnivore in almost all riverine habitats in the lower sections of rivers as well as lakes, relatively few of its bones came to light at Ecsegfalva 23 in comparison with pike. The small proportion between the NISP of pike to catfish (30/338 = 0.1) in the hand-collected fish bone assemblage at the neighbouring Körös culture site of Endrőd 119 (Takács 1992, 304) showed a dominance of catfish. It must be emphasised here, however, that the greater proportion of pike to catfish (803/54 = 14.9) at Ecsegfalva 23 is largely due to the presence of many young pike in the material. Although, partly owing to the small number of catfish remains, no measurable bones were available for the size reconstruction of catfish (Takács 1986), bone fragments from this species were relatively small, suggesting that, similarly to pike, young individuals were caught in the shallow waters of the immediate environment of the site.

Pikeperch (*Stizostedion lucioperca* Linné 1758) is a carnivorous species that may attain a total length of 1–1.5 m and 15–20 kg weight in the largest individuals. Of the species identified in the assemblage, pikeperch has the second highest requirement of dissolved oxygen, 2.0–3.0 mg/l (Pénzes and Tölg 1977, 327). Similarly to sterlet, therefore, it was possibly caught in the active channel of the nearby Berettyó river as well (2.5–3.0 mg/l at 25°C; Bartosiewicz and Bonsall 2004). The small number of identifiable pikeperch remains, therefore, is understandable. Pikeperch was also rare at the Körös culture site of Endrőd 119 (Takács 1992, 303).

Other *homoiotherm* animals identified at the site should be regarded as environmental indicators, rather than major contributors to the diet.

Remains of pond tortoise (*Emys orbicularis* Linné) most likely originate from natural deposits, since none of the 21 carapace fragments found show cutmarks or any other sign of human interaction. In any case, tortoise remains illustrate the marshy conditions that existed in the floodplain area where the site was located.

Similarly, the 589 remains of frogs and toads (Anura), listed in *Appendix Table 20.IV,* are indicative of Neolithic living conditions rather than diet. Their relatively high representation is the likely result of careful water-sieving rather than prehistoric human activity. Most of the bones probably originate from frogs (*Rana* sp.), although only a few of these could be unambiguously identified. Remains of large toads (*Bufo bufo* Linné 1758) are few.

A single, small, claw fragment most probably originates from river crab (*Potamon* cf. *potamius* Linné), although this hypothesis cannot be refined in the absence of reference material. Given this animal's requirement for oxygen rich water, its presence may be indicative of fishing in waters more active than the meander in the immediate neighbourhood of the settlement.

Seasonality

Owing to the difficulty of reliably quantifying fish remains, emphasis in this paper was laid on the presence/absence of fish species and their seasonal interpretation. Water quality impacts on both the timing and success of reproduction for every kind of fish. The ratio of oxygen dissolved in water depends on the speed of current and water temperature (Harka 1993, 86). It is these properties through which seasonality influences both the presence/absence and reproductive behaviour of fish. Freshwater species known from archaeological assemblages in the Great Hungarian Plain were available, more or less, throughout the year. The use of their bones as seasonal indicators, therefore, is limited to probabilistic interpretations.

Familiarity with the reproduction cycle of these animals, however, is of some help in reconstructing seasonal patterns (Bartosiewicz *et al.* 1994, 110). The logic of this reasoning is as follows. Most fish seek shallow waters near river banks as well as residual waters during spawning, where they become both more visible and prone to predation. The simple presence, rather than the age or size of various fish species represented by the archaeological remains, may thus be assigned with greater probability to the season of spawning (Figler *et al.* 1997). On this basis, the tentative seasonality calendar shown in *Table 20.3* may be compiled using the fisheries literature (Berinkey 1966; Pintér 1989) for the species found at prehistoric sites in Hungary.

Table 20.3. The spawning periods of fish known from prehistoric sites in Hungary. Boldface print and heavy shading indicate species identified at Ecsegfalva 23

Species	Jan.	Feb.	Mar.	Apr.	May	Jun.
Pike						
Beluga sturgeon						
Pikeperch						
Carp						
Roach						
Vimba						
Russian sturgeon						
Stellate sturgeon						
Knife						
Rudd						
Ship sturgeon						
White bream						
Undermouth						
Catfish						
Bream						
Barbel						
Orfe						
Tench						
Crucian carp						
Sterlet						
Total n of species	0	1	2	15	19	10
Ecsegfalva 23 species	0	1	1	7	11	7

The relationship between the total number of species identified at 51 prehistoric sites and Ecsegfalva 23 may thus be described with the following regression equation:

$$y = 0.361x + 0.479$$

The high, positive and significant linear correlation ($r = 0.945$; $P \leq 0.05$) between the number of species spawning at different times, identified at several Neolithic sites and at Ecsegfalva 23, suggests that these fish were caught with great probability following the same seasonal pattern at the site under discussion here. The most likely background variables behind this close relationship include the simultaneous annual cycles of both flooding and fish reproduction.

Fish size and age

Age-dependent differences in fish are largely expressed in size, rather than body proportions (Pálsson 1955, 431, fig. 10.1). While estimating the size of fish reveals information on the amount of food a single individual may have yielded, converting size estimates into age contributes additional information on fishing techniques and/or seasonality.

Owing to its numerous measurable bones in the Ecsegfalva 23 assemblage, the size of pike could be estimated on the basis of the allometric relationships between standard skeletal measurements taken after Morales and Rosenlund (1979) and total length, using a sample of 24 mod-

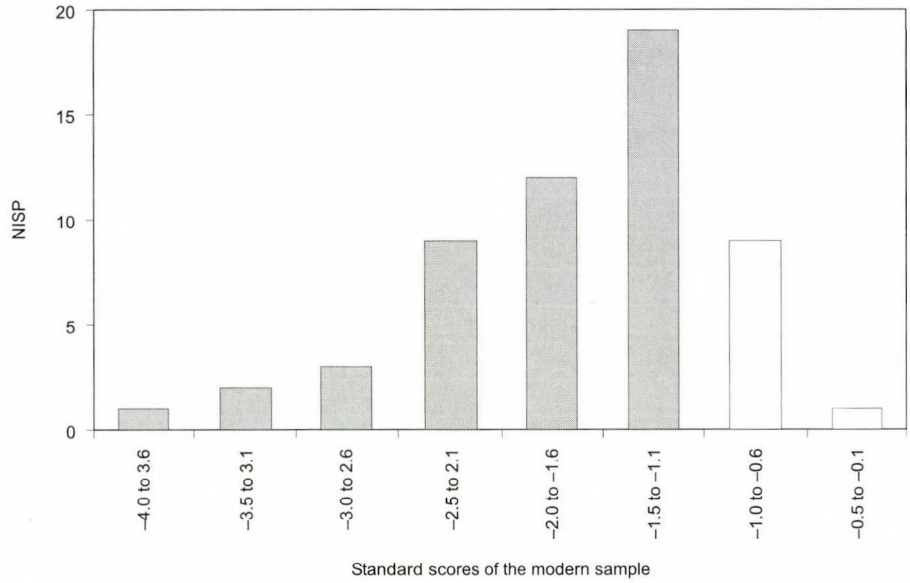

Fig. 20.1. The size distribution of pike bone measurements in comparison with those of 24 modern specimens. Shading indicates specimens 1 SD below the modern sample mean

ern pike skeletons from Sweden (Bartosiewicz 1990a, 28, table II). Although geographical variability is to be expected in the size of these animals, it should not directly affect the allometric relationships between body dimensions.

The mean values and standard deviations of the modern sample (Bartosiewicz 1990a, 30, table III) served in calculating standard scores for each measurable bone from Ecsegfalva 23, regardless of anatomical position. In this way, measurements of different bones could be pooled against the modern sample as a common background. The standard scores of Neolithic skeletal measurements are plotted in *Fig. 20.1.* The fact that most specimens fell short of the 816 mm average total length of the modern sample by at least one standard deviation (shaded in *Fig. 20.1)* indicates that the archaeological assemblage from Ecsegfalva 23 is dominated by small pike. Univariate statistics for the estimated total length of pike from Ecsegfalva 23 are as follows:

	NISP	Mean	Minimum	Maximum	SD	Skewness
Total length, mm	56	380.7	26.1	695.7	142.2	0.019

The mean total length is less than half of what was obtained for the modern reference sample. The skewness value shows that the distribution of these measurements is not far from normal (a trend also visible in the standard scores shown in *Fig. 20.1*).

On the basis of data gathered on live pike in Hungary (Pintér 1989, 52, table 1), age (y, years) may be predicted from total length (x, mm) using the following exponential equation:

$$y = 0.007x^{1.9093} \text{ (r = 0.999)}$$

Figure 20.2, plotted by entering total length estimates into this equation, reconfirms a major concentration of young pike in the Ecsegfalva 23 material. The age profile, expressed in percentual terms in *Fig. 20.3*, shows a heavily skewed age distribution: almost two-thirds (64.2%) of the estimated total lengths correspond to pike caught within the first two years of life. Univariate statistics of the age estimates thus obtained indeed indicate a mean age less than two years, and a heavily skewed age profile:

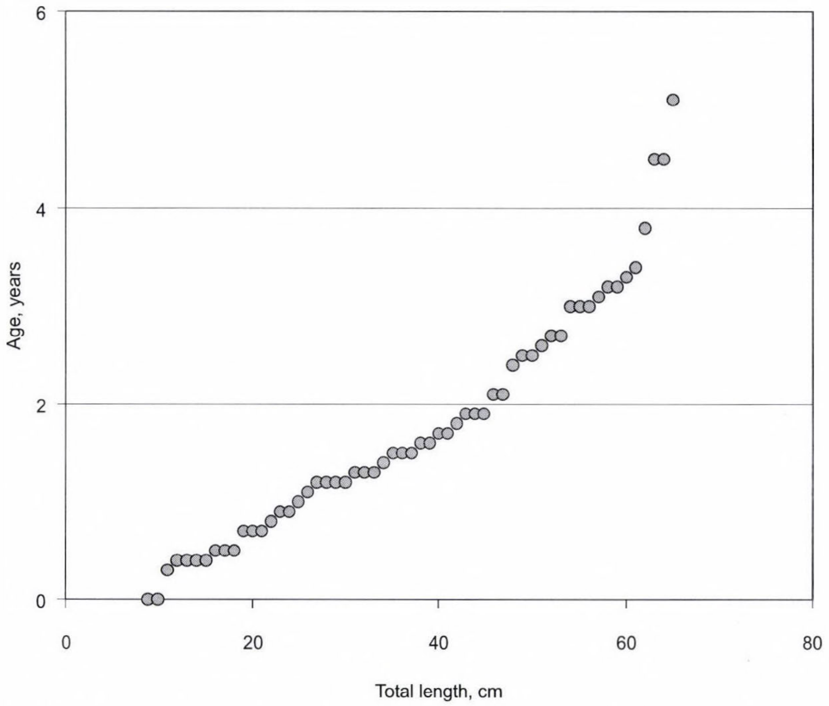

Fig. 20.2. Estimated ages of pike at Ecsegfalva 23 based on the reconstruction of total length. Standard growth data by Pintér (1989)

	NISP	Mean	Minimum	Maximum	SD	Skewness
Age, years	56	1.8	0.0	5.1	1.2	0.779

(The apparent discrepancy in the symmetry between the distributions of total length and age is due to the non-linear relationship between these two variables: longitudinal growth decelerates in older animals.)

The age distribution shown in *Fig. 20.3* is reminiscent of a natural age profile in which the older the age class, the less well represented it is. Extreme forms of this pattern would be characteristic of catastrophic situations such as the depletion of dissolved oxygen in the water during hot summers, in which entire fish populations may be destroyed. A similar pattern of pike size distributions was found at the Mesolithic site of Praestelyngen in Denmark (Noe-Nygaard 1983, 131, fig. 14). When compared to a modern case of lake poisoning (Larsen 1961), however, that author found deviations from the catastrophic age profile and could thus attribute the phenomenon to fishing: 'the dominance of a very limited size range... suggests selective killing of fish, and strongly implies that the fish bones accumulation was due to human activity' (Noe-Nygaard 1983, 130).

The size distribution of pike in the Ecsegfalva 23 assemblage is compared to those of Praestelyngen and the modern poisoned lake in *Fig. 20.4.* Visually, the sizes of Ecsegfalva 23 pike fall between the Mesolithic assemblage from Praestelyngen and the set retrieved from the modern poisoned lake. However, Wilcoxon matched pairs tests, carried out to verify this empirical observation, provided no statistically significant differences between the size distributions of the three assemblages *(Table 20.4).*

Owing to its transitional position between the poles represented by the poison-kill and Mesolithic fishing in Denmark, the Ecsegfalva 23 assemblage may be reasonably considered a product between a natural 'catastrophe' and human interference. In the Great Hungarian Plain, such a

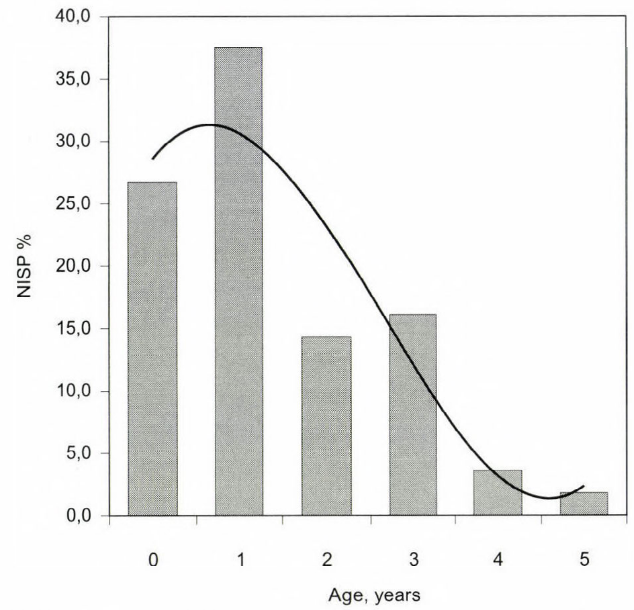

Fig. 20.3. The age profile of 56 pike at Ecsegfalva 23 on the basis of estimated total length

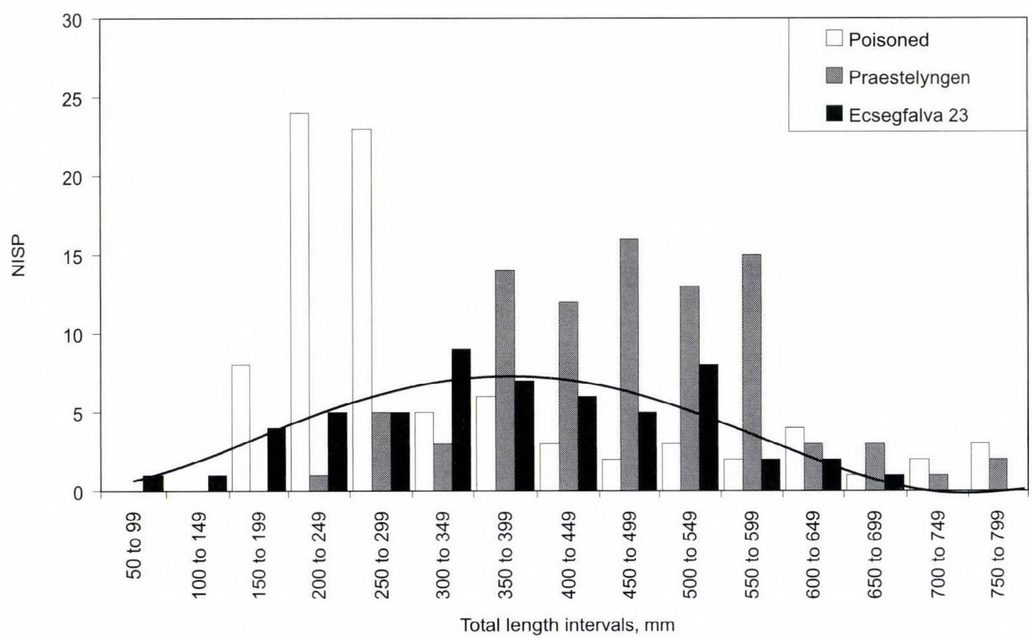

Fig. 20.4. The distribution of pike total length in three assemblages with the trendline of Ecsegfalva 23

situation is relatively easy to imagine. Historical and ethnographic records reveal that as early summer floods receded, millions of fish of all sizes were trapped in residual pools where they could be simply gathered even by hand or 'potting', using large, bottomless baskets. Mátyás Bél, an eighteenth-century Hungarian naturalist, also mentioned the unbearable smell of decaying fish left behind after major floods along the Tisza river (Bél 1764 [1984]).

This possibility at Ecsegfalva 23 is consonant with the size distribution of pike, bearing resemblance to a catastrophic age profile, where most of the population would have been destroyed, as may have been the case with fish stranded in residual pools after a flood. This does not mean, however, that stranded fish died *in situ* at the settlement. Smaller pike in the immediate envi-

Table 20.4. Wilcoxon matched pairs tests between the three pairs of data

	n of size categories	T-value	Z-value	P-level
Ecsegfalva – Praestelyngen	15	30.5	1.381	0.167
Ecsegfalva 23 – Poisoned	15	40.5	0.349	0.727
Praestelyngen – Poisoned	15	42.0	0.245	0.807

ronment of the site were evidently more prone to human predation of even the simplest form: gathering.

Noe-Nygaard raises the possibility of harpooning small pike within this size range at Praestelyngen (Noe-Nygaard 1983, 130). However, artifactual evidence of active fishing remains very indirect at Ecsegfalva 23. It includes small bone double points, often interpreted as fish gorges (Choyke and Bartosiewicz 1994) and massive bone points that, among other tasks, may have been used in net weaving (Alice Choyke, *pers. comm.*, and chapter 29).

The fundamental similarity between the sites in Denmark and Hungary is that the pike caught most likely represent individuals that could be easily targeted in their shallow-water spawning grounds, near the edge of water surfaces. Incremental growth rings in the vertebrae of pike in Praestelyngen indicated a summer kill (Noe-Nygaard 1983, 130), which would be consistent with the seasonal killing of most fish species identified in the Ecsegfalva 23 assemblage.

It must also be emphasised that (together with the plethora of small Cyprinids), it is just this size range of fish that may have been targeted by potting and other simple forms of gathering fish.

On the basis of size, it may be concluded that omnivorous carp had a more homogeneous age profile. The measurement most commonly available was the width of the pharyngeal process, a largely triangular posterior extension of the basioccipital, located above the pharyngeal toothplates of the fifth ceratobranchials in Cyprinids (Rojo 1991, 132).

Descriptive statistics for the width of the *processus pharingeus* (mm) in carp identified at Ecsegfalva 23 may be summarised as follows:

	NISP	Mean	Minimum	Maximum	SD	Skewness
Pharyngeal process width, mm	30	12.1	4.2	18.2	2.9	−0.586

Unfortunately, allometric equations have not yet been developed for the prediction of overall size from this skeletal measurement. However, many of the specimens measured originate from mature individuals around the peak of the largely normal distribution shown in *Fig. 20.5*, and three unusually large carp were also identified. At the other extreme, three measurements taken on tench more or less correspond to the size range estimated for small pike as discussed previously. Carp, as well as most other Cyprinids identified in the material, is a typical fish of shallow waters, where even its large specimens may be easily caught. Except for the early spring spawning season, large pike tend to seek deeper, cooler and cleaner waters than carp.

Conclusions

In comparison with other Early Neolithic sites from Hungary, the Ecsegfalva 23 assemblage contains most species characteristic of the floodplain environment in the Great Hungarian Plain. The species composition of the fish preyed upon directly reflects the position of the settlement within the loop of a great meander (Whittle 2003, 112). The dominance of Cyprinids in the prehistoric fish diet is consistent with an aquatic habitat of slow current and little dissolved oxygen. Almost

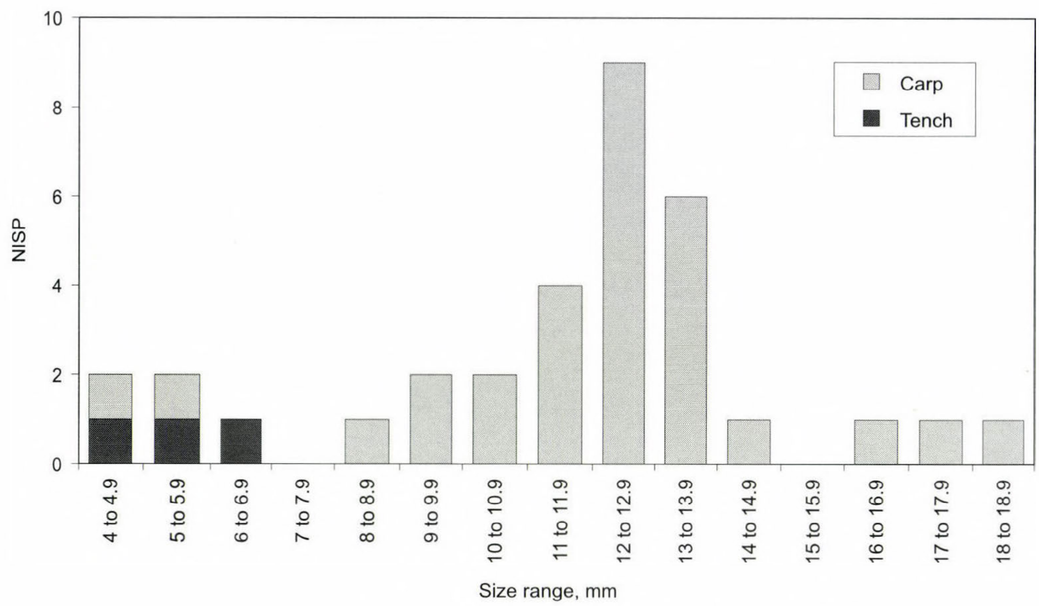

Fig. 20.5. The distribution of *processus pharyngeus* width in Cyprinids

all the fish identified in this assemblage prefer shallow and warm waters. Sporadic exceptions (sterlet, barbel, pikeperch) may be considered cold season stragglers in this habitat or were perhaps caught in active channels in the broader environment of the settlement.

Seasonal fishing may only be indirectly inferred from these remains. The floodplain area around Ecsegfalva 23 probably offered the best catch even for opportunistic fishers during and after the spring-early summer floods, when pools of residual water formed natural traps in the immediate proximity of the settlement. Since this time also coincides with the spawning season of most of the fish species identified, harvests would have been most abundant during this period. Based on analogous Mesolithic finds from Denmark, masses of young pike bones possibly also indicate a related, opportunistic late spring/early summer activity by the occupants of the site.

Since no unambiguous remains of fishing gear were identifiable, gathering fish should be thought of as the primary form of fish exploitation. This, however, does not exclude the possibility either of active fishing or catching fish beyond the spawning season. In purely stochastic terms, however, fish consumption was probably more typical during the summer half of the year.

Appendix Tables

Appendix Table 20.I. Fish remains from Trench 23A

23A	Pike	Carp	Cyprinid	Catfish	Non-identifiable	Total
frontale			15			15
Neurocranium			**15**			**15**
praeoperculare				1		1
suboperculare				1		1
quadratum			1			1
loose tooth	1					1
Viscerocranium	**1**		**1**	**2**		**4**
dorsal fin ray		1				1
vert. precaudalis	1		1		2	4
vert. caudalis		1				1
costa			1			1
Axial skeleton	**1**	**2**	**2**		**2**	**7**
Non-id. flat bone					11	11
Total weight, g	**0.2**	**3.3**	**1.6**	**2.0**	**0.1**	**7.2**
Total NISP (all regions)	**2**	**2**	**18**	**2**	**2**	**26**
Mean weight, g	**0**	**2**	**0**	**0**	**0**	**0.3**

Appendix Table 20.II. Fish remains from Trench 23B

23B	Sterlet	Pike	Roach	Orfe	Tench	Bream	Barbel	Vimba	Crucian Carp	Carp	Cyprinid	Catfish	Pikeperch	Non-identifiable	Total
frontale		4								5	9				18
basioccipitale		5								3		2		1	11
vomer		73													73
parasphenoideum		21								11	2			1	35
proc. pharyngeus					1	2		5		40	8				56
ossa pharyngea inf.		10	6	2	7		3		2	185	46				261
Neurocranium		**113**	**6**	**2**	**8**	**2**	**3**	**5**	**2**	**244**	**65**	**2**		**2**	**454**
maxillare		8					1			1	1	4			15
ectopterygoideum	1														
praeoperculare		1	1		1					9	11	1	1		25
operculare		4	4		7					13	2			1	31
suboperculare		2	1		2					11	13				29
quadratum		39								2	7				48
angulare		3									10			34	47
articulare		37								3	5	1			46
dentale		125			2		1			12	15	2			157
branchyostegale		6									13			1	20
Viscerocranium	**1**	**225**	**6**		**12**		**2**			**51**	**77**	**8**	**1**	**36**	**419**
hyomandibulare		2			6	1	1			15	29	1			55
symplecticum										2	5				7
epihyale		5									10				15
ceratohyale		12									5				17
urohyale		2								2				4	8
Hyoid arch		**21**			**6**	**1**	**1**			**19**	**49**	**1**		**4**	**102**
posttemporale											1				1
cleithrale		182	1		1		1			10	10	6		7	218
scapula										2	7		1		10
pectoral fin ray										5	15	9		4	33
Zonoskeleton		**182**	**1**		**1**		**1**			**17**	**33**	**15**	**1**	**11**	**262**
basipterygium		3		1						8					12
lepidotrichia										6	35			45	86
bognar										9	3				12
dorsal fin ray										2	14			13	29
vert. precaudalis		146	3		7					79	2832	17		2920	6004
vert. caudalis		113	3		2					22	3364	11		3449	6964
costa										15	165			3217	3397
dermal scute	3														
Axial skeleton	**3**	**262**	**6**	**1**	**9**					**141**	**6413**	**28**		**9644**	**16507**
Non-id. flat bone														3412	3412
Total weight, g	**1.6**	**154.0**	**2.2**	**0.2**	**4.8**	**0.6**	**1.8**	**1.4**	**0.1**	**92.8**	**296.1**	**20.9**	**0.1**	**444.0**	**1020.6**
Total NISP (all regions)	**4**	**803**	**19**	**3**	**36**	**3**	**7**	**5**	**2**	**455**	**6615**	**54**	**2**	**9695**	**17703**
Mean weight, g	**0.5**	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.1	0.2	0.1	0.4	0.1	0.1	0.1

Appendix Table 20.III. Fish remains from Trench 23C

23C	Pike	Roach	Orfe	Tench	Vimba	Crucian Carp	Carp	Cyprinid	Catfish	Pikeperch	Non-identifiable	Total
vomer	5											5
basioccipitale								2				2
parasphenoideum	1						1	1				3
proc. pharyngeus		1	2		2		3	2				9
ossa pharyngea inf.		2		3	4		21	3				33
Neurocranium	**6**	**3**	**2**	**3**	**6**		**25**	**8**				**53**
praemaxillare							3					3
operculare	1			1			1	1				4
suboperculare	1							4				5
quadratum	3						3					6
articulare	9							1		1		11
dentale	7						1	1		2		11
Viscerocranium	**21**			**1**			**8**	**7**		**3**		**40**
hyomandibulare				2		2	2					5
symplecticum							1	2				3
ceratohyale	4						2	2				8
Hyoid arch	**4**			**2**		**2**	**5**	**4**				**17**
cleithrale	10	1					1	3			1	16
Zonoskeleton	**10**	**1**					**1**	**3**			**1**	**16**
basipterygium								9				9
lepidotrichia											4	4
bognar											4	4
vert. precaudalis	21						17	85	1		7	131
vert. caudalis	29						10	86				125
costa							3	37			18	58
Axial skeleton	**50**						**30**	**217**	**1**		**33**	**331**
Non-id. flat bone											135	
Total weight, g	**8.4**	**0.4**	**0.2**	**0.3**	**0.5**	**0.1**	**7.9**	**13.4**	**1.0**	**0.6**	**6.6**	**39.4**
Total NISP (all regions)	**91**	**4**	**2**	**6**	**6**	**2**	**69**	**239**	**1**	**3**	**34**	**455**
Mean weight, g	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**1.0**	**0.2**	**0.2**	**0.1**

Appendix Table 20.IV. Remains of frogs and toads from Trenches 23A, B and C

	Anura	Frog	Toad	Total
neurocranium	5			5
mandibula	3			3
thoracic vertebra	3			3
os sacrum	13			13
ribs	89			89
scapula	18			18
humerus	62		4	66
radius	41		1	42
ulna	1			1
pelvis	57	1	7	65
femur	26	1	2	29
tibia	84	1	1	86
complete skeleton	8			8
long bone	161			161
Total NISP	**571**	**3**	**15**	**589**

Appendix Table 20.V. Fish bone measurements in mm (after Morales and Rosenlund 1979)

Species/Skeletal element	Side	Age	Trench	Context	Length	Breadth
PIKE						
articulare	sin.	adult	23B	410		4.5
articulare	sin.	adult	23B	351		6.2
articulare	sin.	adult	23B	383		7.6
cleithrum	dex.	subadult	23B	371	35.2	
dentale	sin.	adult	23B	410	36.1	
proatlas		mature	23B	327		8.0
quadratum	dex.	juvenile	23B	443		2.7
quadratum	dex.	juvenile	23B	443		3.0
quadratum	sin.	juvenile	23B	427		3.7
quadratum	sin.	juvenile	23B	464		3.8
quadratum	sin.	juvenile	23B	433		4.1
quadratum	sin.	subadult	23B	461		4.1
quadratum	sin.	subadult	23B	461		4.1
quadratum	sin.	subadult	23B	419		4.2
quadratum	sin.	subadult	23B	474		4.2
quadratum	sin.	subadult	23B	466		4.3
quadratum	sin.	subadult	23B	450		4.5
quadratum	sin.	subadult	23B	528		4.7
quadratum	sin.	subadult	23B	442		4.9
quadratum	sin.	adult	23B	459		5.2
quadratum	sin.	adult	23B	351		5.5
quadratum	sin.	adult	23B	471		5.5
quadratum	dex.	adult	23B	443		6.1

Species/Skeletal element	Side	Age	Trench	Context	Length	Breadth
quadratum	dex.	mature	23B	444		6.2
quadratum	dex.	mature	23B	351		6.8
quadratum	sin.	mature	23B	356		6.8
quadratum	dex.	mature	23B	342		8.1
vomer	sin.	juvenile	23B	432		2.2
vomer	dex.	juvenile	23B	461		2.7
vomer	dex.	juvenile	23B	461		2.7
vomer	dex.	juvenile	23B	465		2.7
vomer	sin.	juvenile	23B	405		2.8
vomer	dex.	juvenile	23B	405		3.1
vomer	sin.	subadult	23B	483		3.2
vomer	dex.	subadult	23B	466		3.7
vomer	dex.	subadult	23B	464		3.8
vomer	sin.	subadult	23B	354		3.9
vomer	sin.	subadult	23B	355		4.1
vomer	dex.	subadult	23B	428		4.1
vomer	sin.	subadult	23B	450		4.9
vomer	sin.	subadult	23C	529		5.2
vomer	dex.	subadult	23B	461		5.4
vomer	sin.	adult	23C	530		6.0
vomer	sin.	adult	23B	459		6.1
vomer	sin.	adult	23B	442		7.0
vomer	dex.	adult	23B	354		7.1
vomer	sin.	adult	23B	415		7.2
vomer	sin.	adult	23B	441		7.5
vomer	dex.	adult	23B	376		7.9
vomer	sin.	adult	23B	471		7.9
vomer	dex.	mature	23B	376		8.0
vomer	dex.	mature	23B	352		8.2
vomer	sin.	mature	23B	374		8.4
vomer	sin.	mature	23B	301		8.9
vomer	sin.	mature	23B	410		10.4
vomer	sin.	mature	23B	354		50.9
ROACH						
praeoperculum	sin.	mature	23B	466	50.0	
CARP						
frontale	sin.	mature	23B	343	19.8	14.7
ossa pharyngea inf.	sin.	adult	23B	359	35.2	
ossa pharyngea inf.	dex.	mature	23B	359	40.0	
hyomandibulare	dex.	adult	23B	356	12.3	
hyomandibulare	dex.	mature	23B	356	15.8	
hyomandibulare	dex.	mature	23B	359		44.7
proc. pharyngeus		subadult	23B	464		4.2
proc. pharyngeus		subadult	23B	450		5.2

Appendix Table 20.V. Continued

Species/Skeletal element	Side	Age	Trench	Context	Length	Breadth
proc. pharyngeus		adult	23B	450		8.6
proc. pharyngeus		adult	23B	465		9.7
proc. pharyngeus		adult	23B	442		9.9
proc. pharyngeus		adult	23B	424		10.0
proc. pharyngeus		adult	23B	340		10.0
proc. pharyngeus		adult	23B	464		11.0
proc. pharyngeus		adult	23B	409		11.1
proc. pharyngeus		mature	23B	461		11.3
proc. pharyngeus		mature	23B	417		11.8
proc. pharyngeus		mature	23B	396		12.0
proc. pharyngeus		mature	23C	530		12.0
proc. pharyngeus		mature	23B	416		12.3
proc. pharyngeus		mature	23B	340		12.5
proc. pharyngeus		mature	23B	468		12.7
proc. pharyngeus		mature	23B	464		12.7
proc. pharyngeus		mature	23B	356		12.8
proc. pharyngeus		mature	23B	396		12.8
proc. pharyngeus		mature	23B	474		12.9
proc. pharyngeus		mature	23B	464		13.1
proc. pharyngeus		mature	23B	374		13.1
proc. pharyngeus		mature	23B	340		13.2
proc. pharyngeus		adult	23B	466		13.5
proc. pharyngeus		mature	23B	466		13.6
proc. pharyngeus		mature	23B	464		13.8
proc. pharyngeus		mature	23B	450		14.1
proc. pharyngeus		mature	23B	359		16.9
proc. pharyngeus		mature	23B	340	16.0	17.2
proc. pharyngeus		mature	23B	340		18.2
TENCH						
proc. pharyngeus		juvenile	23B	464		4.3
proc. pharyngeus		9	23B	459		5.2
proc. pharyngeus		9	23B	469		6.2

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OF ECSEGFALVA 23, COUNTY BÉKÉS

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CONTENTS

VOLUME I

VOLUME II

Chapter 21

THE ZOOARCHAEOLOGICAL ANALYSIS OF FRESHWATER BIVALVE SHELLS AND THEIR RELEVANCE REGARDING THE LIFE OF A NEOLITHIC COMMUNITY

Sándor Gulyás, Anikó Tóth and *Pál Sümegi*

Introduction

The zooarchaeological analysis of marine bivalves has been the subject of many studies from European (Bailey 1975a; 1978; Swadling 1976; Deith 1983a; 1983b; 1984; 1985; Rowley-Conwy 1983; Fieller *et al.* 1985; Petersen 1986; Waselkov 1987; Andersen 1989; Enghoff 1989; Milner 2001; Bailey and Milner forthcoming), North American and Australian archaeological sites (Bailey 1975b; 1994; Meehan 1982; Jones and Fisher 1990; Claassen 1998; Luby and Gruber 1999; Henderson *et al.* 2002).

However, very few publications with such scope are known for freshwater, fluviatile mussels in Europe. Conversely, several works are concerned with the prehistoric gathering of freshwater mussels on the North American continent. According to the literature, literally millions of freshwater mussels were gathered by the Pre-Columbian aboriginal peoples who lived along the major rivers in North America. These shellfish served as an important supplementary food resource, while the shells themselves were often modified into various tools, such as scrapers, hoes, bowls, spoons, and ornaments (Parmalee 1956; 1988; 1994; 1998; Matteson 1959; Murphy 1971; Parmalee and Klippel 1974; Klippel *et al.* 1978; Parmalee *et al.* 1980; 1982; Bogan 1981; Scott 1982; Taylor and Spurlock 1982; Robinson 1983; Muller 1986; Parmalee and Bogan 1986; Casey 1987; Theler 1987; 1990; 1991; Taylor 1989; Blitz 1993; Claassen 1994; 1998; Peacock 1996; 1997; 2000; 2002; Dorsey 2000; Hirst 2000; Lippincott and Davis 2000; Myres and Perkins 2000; Picha and Swenson 2000; Warren 2000; Peacock and James 2002). From the pearl buttons of the early 1900s to the contemporary cultured pearl industry, shells of freshwater mussels have been used by humans for centuries on the American continent (Peacock 1997; Parmalee 1998). The lack of archaeological studies on freshwater mussels in Europe may be explained on the one hand by the fact that the composition of the freshwater mussel fauna here is very different from that in North America. There are only about ten indigenous species of freshwater mussels (Unionacae: *Margaritifera* and *Unionidae*) in Central Europe (Badino *et al.* 1991; Bogan 1993; Nagel and Badino 2001), whereas the North American fauna is very diverse, with about 290 recognised species and a high degree of endemism (Williams *et al.* 1993; Turgeon *et al.* 1998). Consequently, exploitation of these molluscs can never have been as important as those of marine bivalves in the lives of European communities, except in limited areas and at certain periods during the course of history.

The gathering of freshwater bivalves must have been restricted mainly to the central continental areas of Europe in prehistoric times as proven by the archaeology, yet publications on the zooarchaeological analysis of these are lacking. Conversely, as some past and present-day examples indicate, the exploitation of these mussels was and is still significant in some places on the continent. According to the literature, the meat of freshwater mussels was frequently used as a fodder for pigs and poultry in Germany during the eighteenth century (Brehm 1957–59). In Romania, for example the shells of freshwater bivalves, nominally those of the genus *Unio*, are still exploited for the button industry. Furthermore, their soft tissues are used as fodder in poultry farming (Tudorancea 1972). Similar utilisations of the immigrant Chinese huge mussel (*Anodonta woodiana woodiana*) have been documented from Hungary (Kiss and Pekli 1986; 1987; 1988a; 1988b; Kiss *et al.* 1988; Kiss 1990; 1992; 1995; Kiss and Petró 1992). Culturing of freshwater mussels, namely those of the giant freshwater pearl mussel *Margaritifera margaritifera*, was quite relevant in the UK and other Western European countries in historic times (Cranbrook 1976). The lack of use of the majority of European *Unionidae* for dietary, fodder or pearl culturing purposes today is partly explained by the fact that most of the species are endangered and enjoy increased protection (Bauer and Wachtler 2001). Furthermore, being excellent filtering agents, the meat would not meet the standards suitable for human consumption due to the increased contamination of the rivers and ponds as a result of intensified industrial production over centuries (Bogan 1993; Bauer and Wachtler 2001; Ravera *et al.* 2003).

Nevertheless, as the archaeological record implies, these mussels were readily available for human communities throughout the Neolithic, Bronze and Copper Ages in Hungary (Czógler 1934; Domokos 1980; Horváth 1982; Raczky 1987a; Sümegi *et al.* 1996; Sümegi 1999a; 2003c; Tóth 2003; Gulyás *et al.* 2003; 2004; and this volume). Several hundred kilograms of shell material have been retrieved so far in Hungary as part of the archaeological excavations at Neolithic and Bronze Age sites. However, these have been very rarely subjected to detailed archaeozoological investigations, with a few exceptions like those presented in recent work (e.g. Sümegi *et al.* 1996; Sümegi 2003a; 2003c; Tóth 2003; Gulyás *et al.* 2003, 2004).

The aim of the present study was to go on with this line and try to elucidate something about the dietary habits and gathering modes of a Neolithic community inhabiting a Körös culture site at Ecsegfalva with the help of detailed archaeozoological, morphometric and paleoecological analysis of freshwater bivalve shells retrieved on site. The final results will most likely also shed light on the interrelationship of the various subsistence activities within this community, and the wider social and economic relations as well.

Material and methods

The shell material chosen for detailed analysis derives from within the upper occupation layer in Trench 23B. (Ecsegfalva site 23B: squares A8, A11, A13, B8, B12, B13, C10, C13, C14, D5, D11, D14, E3, E5, E9, E10, E15, E16, F4, F5, F6, F7, F9, F10, F11, F14, F 15, G3, F4/G4, G4, G5, G6, G7, G11, G13, G15, K11, K12, L3, L12, L14, M5, M9, M12, M13/M14, M14/M13; other: Ecsegfalva 16, 479, 423, 486, 480, 430). The context was similar to that of the rest of the upper occupation deposit, and its coherence must have protected the shells from later disturbance and mixing *(Fig. 21.1)* (and see chapter 9). Thus there was every reason to believe that the shells had been discarded after a single gathering/consumption event. In this way the findings of the analyses may be suitable for generalisation to the whole site later on, enabling us to draw conclusions in connection with the rest of the shell material not subjected to analysis in such depth (for obvious reasons of time and cost).

A total of 372 shells have been examined in detail from Ecsegfalva site 23B (for contexts see above). The majority of the discarded shells retrieved, most likely representing kitchen waste, suffered cracking due to compactional stress of the overlying material and topsoil. Yet most of them, complete valves and fragments as well, were suitable for taking measurements, and implementing statistical analysis on the data gained. An additional 745 shells, scattered through the site, were also looked at for the determination of taxa and their habitat preference. The material was analysed with respect to the following issues.

The source of shell material subjected to detailed analysis

In situ mollusc material on the excavation surface of site 23B

Fig. 21.1. The site of the material retrieved for the analysis (photo by A. Whittle and P. Sümegi)

The taxonomic identification of the individual taxa present in the shell material

This first step serves as a basis of other subsequent analyses. Furthermore, it is also an indispensable asset to the reconstruction of the site and environment of shellfishing. For the accurate identification of the species, one needs to have shells with a complete, intact beak or umbo at least. The publications on the recent freshwater species of Hungary have been utilised for distinguishing between the individual taxa based on the shape of the shells, and the characters observable on the hinge area and the beak or umbo (Soós 1943; Richnovszky and Pintér 1979). The subsequent biometric analysis of the complete shells has corroborated the accuracy of the determinations.

The determination of the MNI (minimum number of individuals), and the proportional abundance of the various mollusc species to reconstruct the site and environment of shellfishing, the determination of the frequency and possible length of shell disposal and deposition

The determination of the MNI serves as a starting point for the calculation of the specimen numbers and the proportional abundance or dominance values of the various mollusc species. Based on the ecological needs, the substrate and habitat preferences of the individual taxa, the site and environment of shellfishing could be reconstructed using the values of proportional abundance or dominance in site-catchment analysis (SCA). Thus we may be able to determine whether the mussels were gathered from the nearby oxbow lake of Kiri-tó, or the slightly more distant ancient active riverbed of the Berettyó, 1.5–2 km away (see Sümegi and Molnár, chapters 5 and Sümegi, chapter 8). For this purpose, all complete shells or shell fragments with a beak and/or hinge were sorted into left and right valves. In bivalves, two valves represent an individual. However, due to the selected nature of the material deriving from the disposal of the empty shells by humans, both valves are very rarely preserved together in one place. For the previously mentioned reasons, and as either valve can represent an individual, the valves present in larger numbers in the material were taken to correspond to a single specimen for the calculation of the MNI. Furthermore, the ratio of the left and right valves for the individual species may yield information on whether or not the shells were discarded in connection with a relatively short and single event.

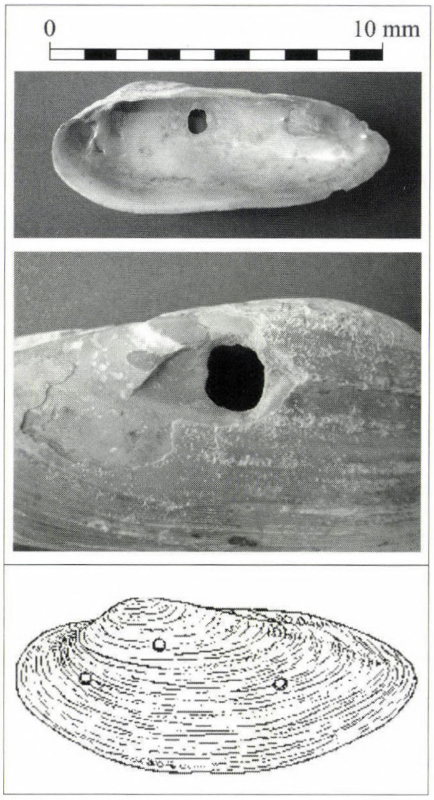

Fig. 21.2. Unio pictorum shell medals from the Late Neolithic site of Hódmezővásárhely-Gorzsa

Information on the utilisation of the mussels: for consumption, as ornaments, tools or as some sort of a tempering agent in pottery

There is every reason to believe, and justified by the literature as well, that during the establishment of a productive society the meat of the mussels gained primarily served as a supplementary food resource. Furthermore, the empty shells were suitable for other uses as well after the meat had been consumed, and were not necessarily just simply discarded.

Unionid shells with drilled holes in the topmost central part, or artificially created chips in the marginal areas have come to light from several Neolithic localities in Hungary indicating the possible use of the shells for ornaments (Czógler 1934; Horváth 1982; Raczky 1987a; Sümegi 1999b; 1999c) *(Fig. 21.2)*. We can only indirectly infer the use of mussels as tempering agents in pottery. The comparison of the chemical composition of the shells with that of the vessels retrieved and interpreted to be of local origin might be a good approach. Furthermore, the identification of blunt edges on the shells as well as the careful observation of the ornamentation patterns on vessels collected at the site might yield some information about their use as potential tools in pottery.

Insight into ancient culinary habits

The dark, brownish, grayish hue of the shells representing scattered signs of burning, and the ash remains on the surfaces of the shell may indicate that the mussels were cooked or roasted in fires before consumption. The lack of such signs may refer to consumption raw, just as oysters are eaten today (Czógler 1934).

The calculation of the quantities and energy content of the meat gained from the shells

These values are used for determining whether the mussels served as a main or only a supplementary food source. This information may also reveal the approximate number of individuals the total meat could have provided for on the basis of the nutrition content of the soft material. In order to determine the live weight of the animals, along with the weight of their soft material or meat, and the derivable energy content, the main biometric parameters of the shells (shell height (H), shell width (W), the index of flatness = H/W, weight of the shells) should be recorded. These parameters, where possible, were captured with the help of a caliper at an accuracy of 0.5 mm. The weight of the shells was recorded using laboratory scales. The size and shape variants were used as an input into further analyses. Kiss (2000) has carried out detailed morphometric and population ecological investigations on living *Unionidae* from River Tisza in Hungary and found a strong correlation between the width of the shells and the live weight as well as the weight of the soft material via regression analysis. Where we could gain a measurement of shell widths, the species-dependent empirical formulae of Kiss (2000) were used to calculate the living weight and the derived meat of our studied mussels *(Table 21.1).*

From these values the energy content available for humans could be more or less precisely estimated along with the number of people it could have provided for. According to the relation reported by Tudorancea and Florescu (1968) for *Unionidae,* 1g dry weight of the meat equals 4488.1 cal. Knowing the ratio between wet and dry weight of the soft tissues of *Unio* (5.38), it was calculated that 1 g of wet weight is equivalent to 834.22 cal (1 kg = 834 kcal) (Ravera and Sprocati 1997). In other words these freshwater mussels yield more proteins and nutrition than their marine counterparts (the calorie content of marine bivalves was estimated to be 600 kcal per kg) (Clark 1972; Bailey and Milner forthcoming). Unfortunately, in case of the majority of the shells only shell heights could have been recorded. As there is a strong correlation between shell heights and width in these mussels (r = 0.87) during growth, similar empirical formulas have been set up for the individual species by us, using the original data of Kiss (2000) by his courtesy *(Table 21.1).*

Information regarding the selectivity of shellfishing and the shell gathering strategies applied

People may exercise preference for particular species and particular size groups because of nutritional factors, labour requirements and ease of access, to say nothing about taste preferences, social practices or cultural idiosyncrasies. Foragers preying upon freshwater molluscs, like rats, muskrats and humans too, generally show a preference for larger, older specimens to the limit of their handling capacities (Convey *et al.* 1989; Hanson *et al.* 1989; Richardson and Yokely 1996; Zahner-Meike and Hanson 2001; Ravera *et al.* 2003). By preparing frequency histograms for the size data (shell height or shell length), which displays a strong correlation with the age of the mussel as a result of accretionary shell growth, and determining the univariate statistical parameters (standard deviation, mean, skewness, kurtosis), we can see whether or not the gatherers of the Neolithic community collected the shells selectively. This way we can get some overview

Table 21.1. The equations used for the calculation of live weight and meat weight of the mussels (L = length of the shell; H = height of the shell, LW = live weight; WW = meat weight)

1. Calculated parameters of the three Unionid species (after Kiss 2000)

Species	X	Y	Regression	Type	r^2	N
U. crassus	L(mm)	LW(g)	Y = 5.49E-04*X^2.630	exp	0.798	32
U. crassus	L(mm)	WW(g)	Y = 8.29E-05*X^2.816	exp	0.766	32
U. pictorum	L(mm)	LW(g)	Y = 2.45E-04*X^2.784	exp	0.948	27
U. pictorum	L(mm)	WW(g)	Y = 1.35E-04*X^2.658	exp	0.915	27
U. tumidus	L(mm)	LW(g)	Y = 2.03652-04*X^2.83052	exp	0.955	28
U. tumidus	L(mm)	WW(g)	Y = 0.430706*X^0.912775	exp	0.932	28

2. Calculated parameters with X = shell height for the three Unionid species using the unpublished data of Kiss 2000

Species	X	Y	Regression	Type	r^2	N
U. crassus	H (mm)	LW (g)	Y = 4.48E-04*X^3.22774	exp	0.848	77
U. crassus	H (mm)	WW (g)	Y = 6.90762E-04*X^2.74039	exp	0.766	77
U. pictorum	H (mm)	LW (g)	Y = 1.42073E-03*X^2.94331	exp	0.891	27
U. pictorum	H (mm)	WWg)	Y = 8.7871E-04*X^2.79654	exp	0.908	27
U. tumidus	H (mm)	LW (g)	Y = 4.39812E-04*X^3.19665	exp	0.946	28
U. tumidus	H (mm)	WW (g)	Y = 3.30106E-04*X^2.95259	exp	0.903	28

about their preferences for certain size or age groups within the fauna, as well as the intentional, planned nature of shell fishing. Furthermore, the type of distribution (uni-, bi- or multimodal) may also inform us if the shells come from the same population and were collected and discarded at the same time.

Modern analogies of freshwater mollusc sampling, as well as the evaluation of the data depicted on the histograms may also shed light on the applied method of shellfishing. In other words we can see whether the mussels were collected by hand or in some other sophisticated way. According to sampling experiments carried out by hand (Hanson *et al.* 1989; Richardson and Yokely 1996), both visual and tactile searching by humans are quite inefficient for collecting mussels of < 35 mm length, because these smaller mussels are generally buried too deep in the substrate for humans to detect by hand. Consequently, though there is no direct evidence for collection by hand in the literature, the dominance of larger classes and the lack of smaller classes of size in the analysed material may refer to such a mode of gathering. However, the amount of smaller gastropod shells, dwelling in the same habitat and on the same substrate as the large mussels, should also be taken into consideration for verification.

With the help of density values for the three Hungarian *Unio* species in rivers, ponds and oxbow lakes with similar benthos conditions and faunal composition as the system under investigation (Horváth 1955; Tóth and Bába 1980; Kiss 1996), a relatively good estimate can be made of the extent of the site of collection with the MNI to hand.

Information on the time or season of collection

In contrast to marine forms (e.g. Deith 1983a; 1983b; 1985; Rowley-Conwy 1983; Petersen 1986; Bailey and Milner forthcoming), freshwater mussels in rivers, ponds and oxbow lakes are generally available for humans during the seasons of active growth, usually between April and November in temperate continental climates, when the waters are free of ice, and collection is easy to implement. This is especially true in a complex environment like the Carpathian Basin, formed as a result of the mutual interaction between several climatic influences, the exuberant vegetation and soil types yielding a mosaic-like patterning in the environmental components (Sümegi and Kertész 1998; 2001; Sümegi *et al.* 2003).

However, the actual season of collection may shed interesting light on the factors which may have influenced the timing of collection, like the need for an easily available food source during the construction of a new settlement when other forms of subsistence activities are out of the question, or the need for supplementary food resources in times of harsh environmental conditions throughout the year. Furthermore, it may yield important information on the social and economic relationship of communities (Claassen 1998; Bailey and Milner forthcoming).

Acquiring reliable information and accurate interpretations is not a simple matter, requiring the exact knowledge of growth and shell structure characteristics of the species under study. The shell structure and shell growth of freshwater naiads are relatively well understood and documented today (Carell *et al.* 1987; Timm and Mutvei 1993; Mutvei *et al.* 1994; Dunca and Mutvei 1996; Westermark *et al.* 1996; Checa 2000; Mutvei and Westermark 2001). The naiad shells are composed of two principal aragonitic layers: an outer prismatic and an inner nacreous layer. On the outside the shells are covered by the periostracum, a protein-like substance preventing the dissolution of the shell material. In temperate climates, due to cessation of growth in the winter, the periostracum shows concentric winter lines (annuli), which may be used to estimate the age of the animal. The practice of counting growth rings on the surface of the shells is a frequently used method to determine the age of freshwater molluscs (Crowley 1957; Haukioja and Hakala 1978; 1979; Carell *et al.* 1987; Neves and Moyer 1988).

However, the use of external shell growth patterns in most species, especially freshwater forms in temperate climate, has been found to be rather limited. This derives from the inability to distinguish true periodic structures on shell surfaces from random disturbance marks, and the difficulty in obtaining accurate ring counts because of extreme crowding toward the edge of old shells (e.g. Økland 1963; Magnin and Stanczykowska 1971; Jones 1989; Peacock 2000). Not to mention the fact that the layer of the periostracum is usually eroded and missing from the surface of specimens retrieved during archaeological excavations, hampering the accurate determination of growth rings by the naked eye.

The study of periodic growth structures within the shells can yield much more accurate results regarding seasonality. Periodicities are preserved as alternating light and dark increments in the bivalve shell. These range in size from a few microns to a few centimeters and are thought to reflect periodicities such as sub-daily tidal cycles, daily light-dark cycles, fortnightly tidal-cycles, and annual (seasonal) temperature cycles (Jones 1989; Richardson *et al.* 1993; Quitmeyer *et al.* 1997; Richardson 2001; Wurster and Patterson 2001). Microgrowth increments are produced by changes in the ratio of calcium carbonate to organic matter within the shell. During optimal environmental conditions, bivalves actively pump water from the overlying water column. Respiration is aerobic, and inorganic shell material, calcium carbonate, is deposited. When environmental conditions deteriorate, the valves close, isolating the bivalve from the surrounding environment until conditions improve. Respiration proceeds along anaerobic pathways, and organic-acid waste products accumulate within the closed shells where they are neutralised by the dissolution of calcium carbonate in the shell. This dissolution produces a layer of insoluble organic residue on the inner shell surface. When the bivalve resumes active pumping with the improvement of environmental conditions, deposition of calcium carbonate shell material resumes, preserving the organic layer as a record of the time of shell closure (Lutz and Rhoads 1980).

Growth banding in freshwater bivalves has been attributed to annual-scale climatic seasonal cycles, called annual bands; and random events, called pseudoannual bands (Coker *et al.* 1922; Tevesz and Carter 1980). Annual bands feature thick, dark-coloured, slower growth increments marking winter growth deceleration and cessation separated by thick, light-coloured normal growth increments forming during the active growth season. These are best viewed on cross-sections taken from the umbo to the growing shell margin *(Fig. 21.3)*.

Annual bands are produced in response to reduced cell calcification rates in temperate climates by hibernation, resulting in sustained valve closure during the winter season (Coker *et al.* 1922; Negus 1966). In tropical climates, where the temperatures are more or less stable, they may refer to changes in precipitation rates (Good in press).

Pseudoannual bands are relatively thin, incompletely developed around the entire shell perimeter, variable in colour and texture, and lack regular spacing or periodicity (Stansberry 1961; Tevesz and Carter 1980; Timm and Mutvei 1993; Mutvei *et al.* 1994). Pseudoannual bands are produced by an event that forces the bivalve to suspend pumping and isolate itself from the overlying water column by closing its valves, such as attempted predation or turbidity produced by isolated storms, or any other sudden changes in environmental factors. Pseudoannual dark increments are much thinner than annual dark increments due to the shorter duration of pseudoannual events and are not so easy to recognize *(Fig. 21.3)*. Most of these smaller-scale increments can be studied only with the aid of a microscope.

As it has been mentioned previously, the cause and timing of the formation of pseudoannual and annual increments is largely related to longer or shorter alterations in the environmental conditions. Establishing a reliable sclerochronology suitable for use in archaeological studies like those developed for several marine forms (Deith 1983a; 1983b; 1985; Rowley-Conwy 1983; Petersen 1986; Quitmeyer *et al.* 1997; Claassen 1998; Bailey and Milner forthcoming) is not an easy task. It requires that the growth of the given bivalve species should be accurately docu-

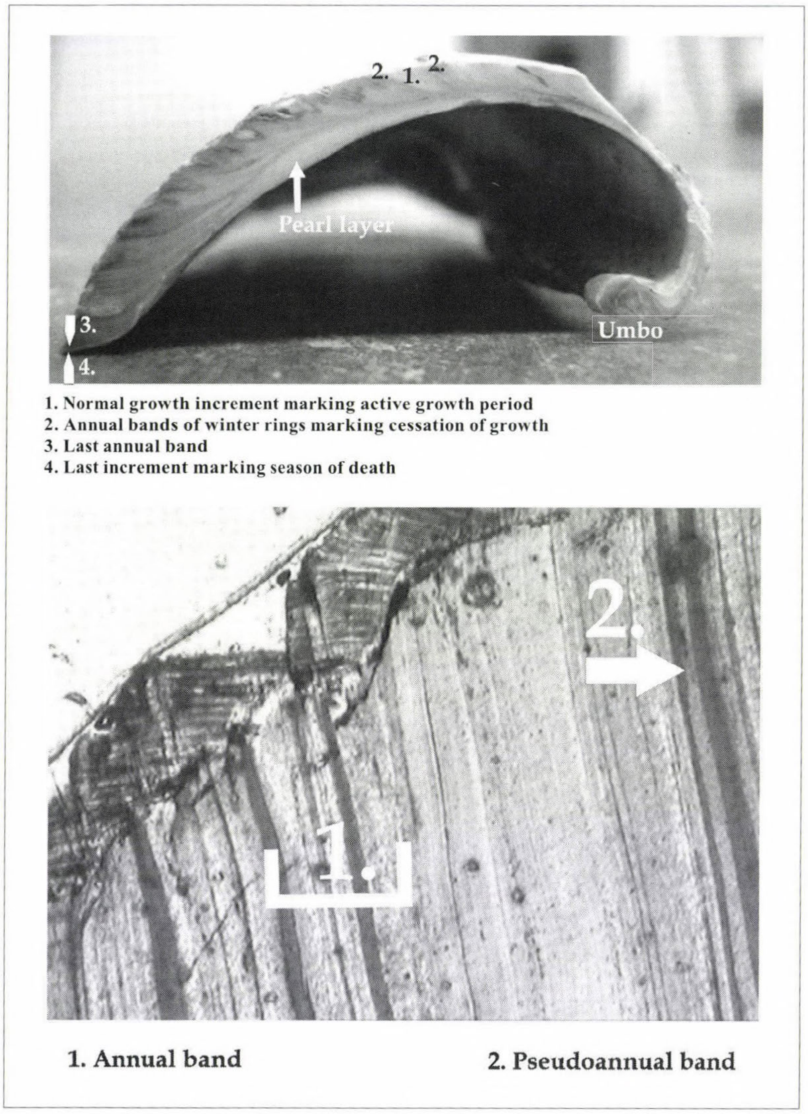

Fig. 21.3. The elements of shell growth structures in *Unionidae* at the macro- and micro-scale used in seasonality analysis

mented both at a macro- and a micro-scale. Interpreting seasonality on the basis of the alternating dark and light increments is relatively easy in case of the marine forms, where we are faced with relatively stable habitat conditions, enabling the persistence of a year-long growth-season. Conversely, the frequent fluctuations of environmental conditions introduce a potential variability in the formation of microgrowth increments in the case of freshwater mussels, hampering the possibility of easy high-resolution age and seasonality determinations.

In case of the Hungarian *Unionidae* most of the growth-related studies were based on the counting and measurement of the adjacent growth rings on the surfaces of the shells (Entz 1932; Sebestyén 1939; Pónyi *et al.* 1981; Kiss and Pekli 1986; 1987; 1988a; 1988b; Kiss *et al.* 1988, Pónyi 1990; Kiss 1990; 1992; 1995; Kiss and Petró 1992). However, the analysis of microgrowth increments providing a suitable analogue for age determination beyond the seasonal scale is lacking.

Nevertheless, extensive foreign studies are available on the growth and annual microgrowth increment formation of the same Unionid species as at Ecsegfalva 23 (Timm and Mutvei 1993; Mutvei *et al.* 1994; Dunca and Mutvei 1996; Westermark *et al.* 1996; Dettmann *et al.* 1999; Checa 2000;

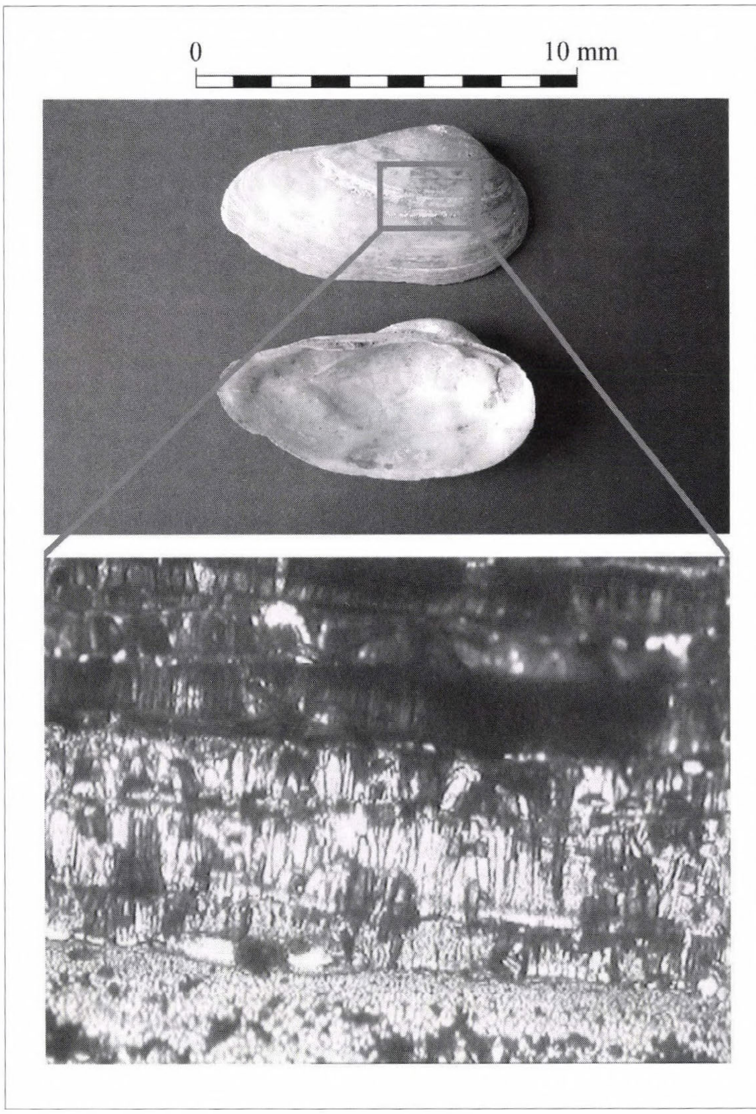

Fig. 21.4. Acetate peel from the surface of the shell of *Unio tumidus* (R.) (100x)

Mutvei and Westermark 2001). These served as relatively acceptable analogues in the interpretation of microgrowth patterns visible on our forms collected from Trench 23B. However, due to differences in climatic and environmental conditions which prevailed in the Carpathian Basin in historical times and today, contributing to a mosaic-like complexity and diversity present at a macro-, meso- and micro-scale in the basin and at the site as well (Sümegi and Kertész 1998; 2001; Sümegi *et al.* 2003; and see Sümegi, chapter 8), our suggestions on the resolution of seasons are only preliminary and will necessitate further investigation.

In order to determine the death of the mussels and the season of collection at the site, the ideas and practices mentioned above were followed. A part of the shells were sectioned from the umbo to the growing shell margin and the received polished cuts were analysed under a stereomicroscope at a magnification of 25x to observe the last annual band and the last growth increment in order to establish the possible season (spring, summer, autumn) of death *(Fig. 21.3).* In order to corroborate these rough and low-resolution predictions, thin-sections were prepared of some selected shells and analysed under a petrographic microscope at a magnification of 50x. Besides these, acetate peels were made of both the transversally sectioned shells, and the whole shell surfaces following the method of Sato (1999) *(Fig. 21.4).*

This approach has been quite promising in the life-history analysis of marine bivalves (Richardson *et al.* 1993; Sato 1999). The acetate peels were examined under a microscope at a magnification of 100x with the aim of correlating the growth patterns observable on the shell surfaces with the microgrowth increments of the thin-sections and peels taken from the transversally sectioned shells. We wanted to develop a method which is more rapid, less expensive and sophisticated than the preparation of thin sections, enabling a quick, reliable and mass evaluation of seasonality on a larger sample of shells.

Results

Out of the 372 shells analysed, 26 were complete valves, 149 were suitable for taking height measurements yielding a total of 175 valves suitable for statistical analysis. The remaining 197 specimens were shell fragments where only the taxonomy could be determined, precluding their use in statistical analysis and the prediction of the biomass *(Table 21.2).* According to the results, the representatives of three major taxa were present in the sample, namely those of *Unio pictorum* (Linné 1758), *Unio crassus* (Retzius 1788), and *Unio tumidus* (Retzius 1788). These elements are also present in the modern fauna of Hungarian rivers and ponds, rendering them ideal analogues in the analysis of archaeological shell material (Soós 1943; Richnovszky and Pintér 1979).

As either valve can represent an individual, the valves present in larger numbers in the material were taken to signify a single specimen for the calculation of the MNI. The 372 valves must have corresponded to a total of 193 specimens of the three taxa (MNI) *(Table 21.2).* From the MNI of the individual taxa, the following proportional abundance values were determined as depicted on the pie-chart of *Fig. 21.5: Unio pictorum* (Linné 1758) = 37%, *Unio crassus* (Retzius 1788) = 54%, *Unio tumidus* (Retzius 1788) = 9%. This species composition corresponds well to the fauna collected by Kiss (1996) from the River Berettyó at a water-depth of 0.4 m from a sandy substrate. Based on the ecological needs and habitat preferences of the individual species, as well as the results of palaeoecological analysis of the profiles at Kiri-tó presented in chapter 5, the following conclusions can be offered.

The species *Unio crassus* generally prefers moving water habitats, with its modern representatives present in the nearby recent Berettyó river as well, dwelling on the sandy substrate close to the main channel line. *Unio pictorum* prefers stagnant water habitats, its modern representatives populating ponds, oxbow lakes, and littoral, protected parts of rivers dwelling on a muddy substrate. *Unio tumidus* also prefers stagnant waters dwelling on the muddy substrate in similar habitats to the previous species. Of the three species found at the site, the latter two were also present in the sedimentological profiles of the Kiri-tó and their modern representatives can be found in the nearby River Berettyó as well (Kiss 1996; and see Sümegi, chapter 8).

The clear dominance of *Unio crassus* (Retzius 1788), otherwise missing from the sedimentological profiles of Kiri-tó, as well as the almost identical species composition of our material with that of the modern forms of the River Berettyó collected recently as part of various population ecological studies (Horváth 1955; Tóth and Bába 1980; Kiss 1996), seem to indicate that these shells were exclusively gathered from the Holocene active channel of this river at a distance of 1.5–2 km north of the site (and see *Fig. 21.6*).

According to the large number of paired valves in the study sample *(Fig. 21.7)*, the disposal of the shells must have been linked to a single collection event, corroborating our previous assumptions drawn from the stratigraphic position of the material. In other words all shells from the archaeological deposit must have been collected at the same time.

Table 21.2. Number of valves for the different taxa of *Unionidae* (the underlined numbers mark MNI)

Species	Complete valves (pc)	Fragments with measurable height (pc)	Fragments unsuitable for measurements (pc)	TOTAL
Unio tumidus right valve	1	7	9	**17**
Unio tumidus left valve	1	11	1	**13**
Unio pictorum right valve	5	23	42	**70**
Unio pictorum left valve	3	29	39	**71**
Unio crassus right valve	8	38	50	**96**
Unio crassus left valve	8	41	56	**105**
TOTAL	**26**	**149**	**197**	**372**

According to the literature, the average population densities of the three Unionid species in rivers with similar benthos conditions as the Berettyó range between 60–100 specimens/ m^2; the rate is between 50–70 in well-oxygenated oxbow lakes (Kiss 1996). Presuming that the collection of the material of the sample was from the Berettyó alone, it must have been restricted to a relatively small area of only 1 or 2 m^2, requiring the work of most likely a single person *(Fig. 21.6).*

As we have stated earlier, the mussels collected must have been used for consumption primarily. After careful observations, we came across some perforated valves in the studied material, probably representing pendants. This is a clear sign of cultural bond to the original maritime environment, where the cradle of this Early Neolithic cultural group resides. Furthermore, the empty shells might have been used as tools for making ornaments on vessels as well.

We have some concerns about the use of bivalve shells as possible tempering agents in pottery at this site. On the one hand this process results in a complete destruction of the shells. However, the material recovered from the site must be attributed to waste disposal as this is the only way these empty shells could have remained in the culture layer. It may also be possible that originally more bivalve shells had been collected than discarded, and some of the empty shells were ground to be used in pottery as a tempering agent. On the other hand, the shells of Unionid bivalves are relatively thick, and not so easy to powder to a fine and relatively homogenous quality. Furthermore, the thick periostracum yields large amounts of impurities in the tempering agent. The successful removal of this uppermost organic layer from the shell seems unlikely at that level of technical development. Conversely, it is more probable that the gathered thin-shelled aquatic gastropods of *Lymnaea stagnalis* and *Planorbarius corneus*, which have come to light in large quantities from Trenches 23B and 23C (see Sümegi, chapter 8), were used primarily as tempering agents in pottery. The unusually large specimens of the latter species found at the whole site seem to further corroborate this assumption.

In the material recovered from Trench 23B (for contexts see above), no signs of burning, roasting or any changes in the hue indicating such activities could be identified on the *Unio crassus* valves. This may refer to consumption without cooking, as is the case with oysters today (Czógler 1934).

Once it is clear that the mussels primarily served as food, then another

The proportional abundance or dominance values of the individual taxa calculated from the MNI

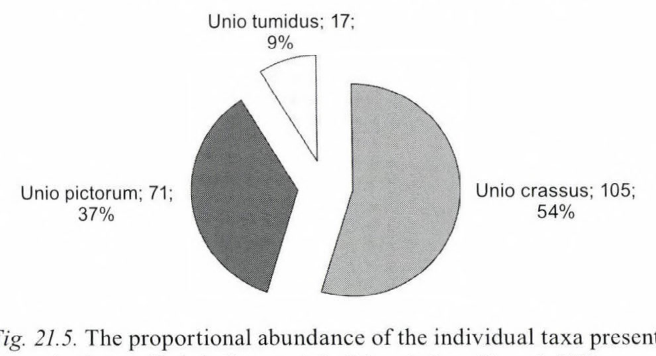

Fig. 21.5. The proportional abundance of the individual taxa present in the studied shell material of the pit from Trench 23B

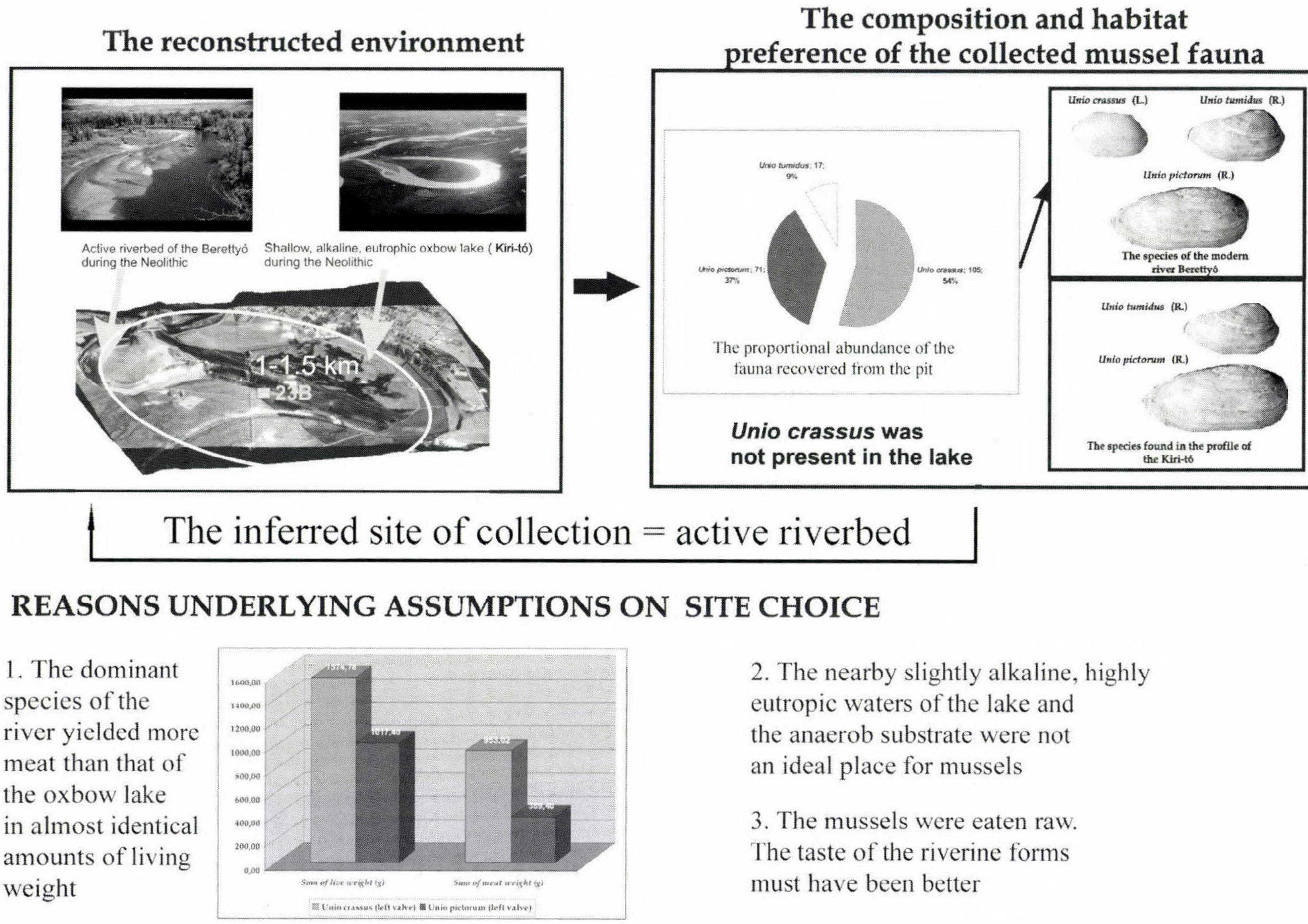

Fig. 21.6. The steps and results of zooarchaeological and site-catchment analysis of the studied material

interesting issue might be the determination of the amount of the meat gained from the shells along with the possible energy content. It may also yield information on the number of individuals the total meat provided for, knowing that their gathering and disposal might be linked to a single event within the household. Out of the total 189 specimens present in the sample, estimates could be prepared only for the 93 complete valves and those with a measurable height as the indicator of size. The predictions were made according to the methods presented above. The total live weight of the prevailing 49 *Unio crassus* was around 1.5 kg yielding a meat weight of 953 g. The 32 specimens of the second largest group, *Unio pictorum*, yielded a total live weight of 1.017 kg corresponding to a meat weight of 389 g. The remaining 12 specimen of *Unio tumidus* had a total live weight of about 214 g yielding a meat of 67.13 g. When we look at these numbers more closely, it becomes quite obvious why the first species was the preferred target of shellfishing. Although the quantities of the two species are almost identical in the sample, considering their live weights (1.5 kg vs. 1 kg), the first one yielded almost 1.6 times as much meat as the second one *(Fig. 21.8)*. This may be attributed to the more robust shells of *Unio pictorum* in comparison to *Unio crassus*. So spending more energy and time on collecting the relatively smaller specimens of *Unio crassus* was worth the effort, as although more specimens had to be collected, in the end they yielded more meat and thus energy than the seemingly larger specimens of *Unio pictorum (Fig. 21.6)*.

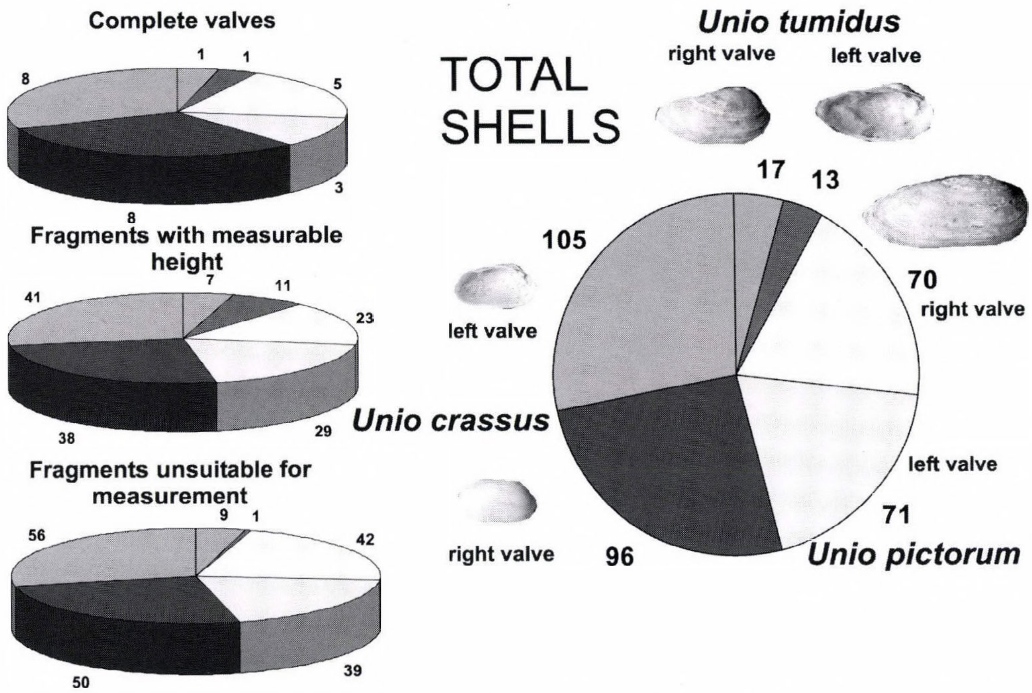

Fig. 21.7. The proportion of paired valves in the material for the total amount of shells, the complete valves and shell fragments with and without measurable parameters

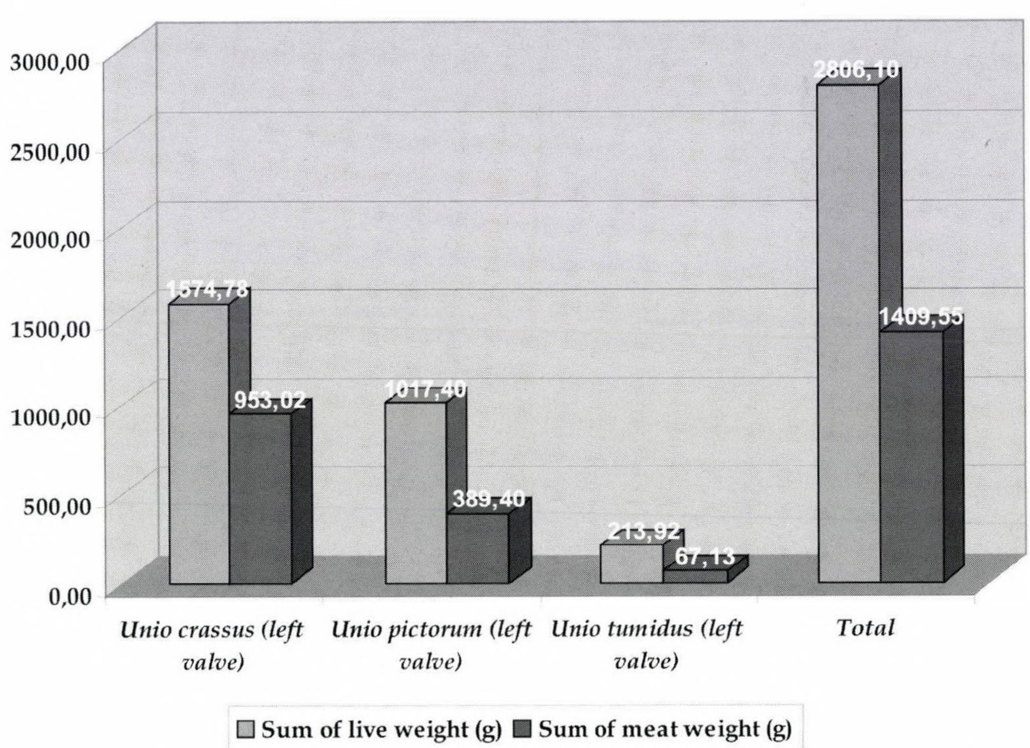

Fig. 21.8. The distribution of calculated living weight and meat weight between the individual taxa and the whole sample in the order of species dominance

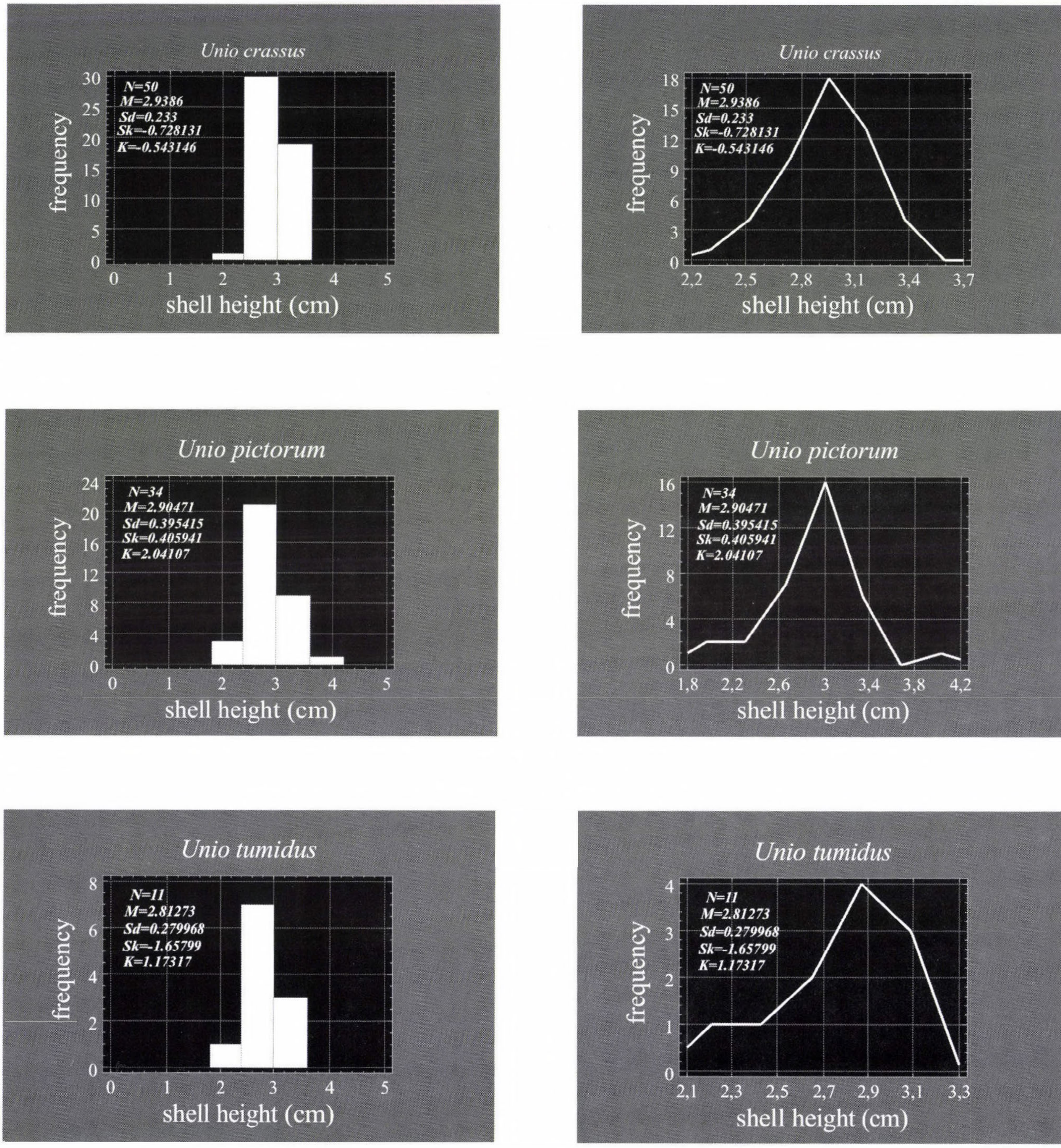

Fig. 21.9. The size distribution of the three measured species in the order of dominance within the sample suitable for statistical analysis

The total live weight of the 93 analysed shells was around 2.8 kg corresponding to an amount of meat of 1.4 kg. In terms of energy content it equals to 1167 kcal, which is barely the daily need of a child or a young female. Keeping in mind that the total number of the remaining specimens (93) inferred from these fragments almost equals that of the shells used for biomass calculations

(96) *(Table 21.2)*, and that the mussels were gathered at the same time, we can just simply double our final values of the gained meat weight. This way we get a total meat weight of 2.8 kg for the whole shell material retrieved from the sample context, providing nutrition of 2334 kcal, the daily need of an adult male. Consequently, the mussels must have served only as a supplementary food resource.

In some recent localities within Hungarian rivers, Unionid mussels contain a major part of the benthic biomass. According to observations implemented in the rivers Tisza, Sajó and Takta, with similar benthic conditions as our referred stream of the Berettyó mussel densities range between 50–100, 20–25 and 5–15 specimen/m^2 (Kiss 1996). Thus the area of collection for the 189 specimens must have been restricted to a couple of m^2, which one or two persons could have easily exploited in a relatively short time. By utilising the rates of average biomass production in recent Hungarian rivers, ranging between 2000–4000 g/m^2, together with the calculated meat weight values for the 189 specimens of the pit examined, and assuming a similar size distribution, we can also roughly estimate the total meat yield of the remaining 732 shells scattered through the archaeological site and not subjected to detailed analysis, to be around 10 kg. This value also corroborates the supplementary role of shellfish in the diet of the Neolithic community, as it could have supported a total of 3 adult males. Even if we assume that half of the shell material was destroyed to be used in pottery, and not available for evaluation, then the doubled value of the total meat would still have met the needs of only a fairly small part of the whole population of the site.

The evaluation of frequency histograms for size data yielded further interesting information about the selectivity and mode of shellfishing. It can be stated that despite the small sample size the smaller classes (< 1.9 cm height) are generally missing in the data for all three species *(Fig. 21.9)*. The standard deviation values further corroborate the assumptions according to which primarily the larger and older shells were collected, as expected, since the larger specimens tend to yield more edible meat in general. The strictly unimodal distributions of the size values for all three specimens further corroborate the assumptions according to which the gathered mussels must have come from a single population, and one place, and most likely as a result of a single shellfishing event. Nevertheless, as we have seen, it is not only the size of the shell that counts, but the attainable meat as well as the choice of the site of shellfishing. The general lack of juvenile forms may relate to collection done by hand in case of the sample material. However, the presence of tiny gastropods, not suitable for consumption, from the mollusc material from the site as a whole, brings up the possibility of another type of shellfishing method, without the use of nets or harpoons and referred to in the previous chapter as well, namely the use of fishing kits or open-bottom fishing baskets (see also discussion in chapter 8).

Finally, according to the preliminary results of seasonality analysis we could infer a season of summer collection for the majority of the shells. This further corroborates the role of the mussels as a food supplement probably consumed as part of a regular meal inside the house, without any special need necessitated by harsh conditions.

Summary of the results of zooarchaeological and site-catchment analyses

The detailed zooarchaeological and site-catchment analysis of the bivalve shell material retrieved from Trench 23B yielded significant information regarding the lifestyle, taste, and common sense of people populating the Körös culture site of Ecsegfalva 23 *(Fig. 21.6)*. According to the results, the representatives of three major taxa were present, namely those of *Unio pictorum* (Linné 1758), *Unio crassus* (Retzius 1788), and *Unio tumidus* (Retzius 1788), which populate Hungarian rivers, ponds and lakes still today. Based on the ecological and habitat preferences of the individual species signified by the proportional abundance rates, plus their presence/absence within the prehistoric Holocene sediments of the Kiri-tó and the modern-day fauna of the River Berettyó, the possible site or environment of shell fishing could be inferred.

In accordance with our findings a theory of intentional differential site selection in shellfishing is proposed. According to this theory, the mussels were collected strictly for consumption, and the shell material must have exclusively originated from the more distant active channel of the Berettyó located at a distance of 1.5–2 km north of the archaeological site, and not from the nearby oxbow lake of the Kiri-tó. We would like to sum up the evidence underlying our theory in relation to two core statements.

Mussels must have been gathered for food because:

1. The small amount of shells recovered from sample context yielded meat and nutrition meeting the daily needs of a single male only (2.8 kg meat = 2334 kcal). Even if the nutrition of the remaining valves not subjected to analysis is also considered, the total meat would support only a minor group of people of 9–10. This is a clear sign that the freshwater mussels were only supplementary in the diet of these ancient communities.
2. This is further corroborated by the fact that the mussels were collected during the late summer, according to rough estimates on seasonality, when environmental conditions must have been relatively stable. Thus the inhabitants of the site must not have been strictly dependent on mussels for survival at this time of the year. In other words, shellfishing might have been aimed at making meals more varied, though the possible role of food shortage due to poor crop yields cannot be fully excluded. The importance of this latter factor in shellfishing requires further investigation.
3. The empty shells were suitable for any type of utilisation as tools or raw material, once the meat had been consumed.
4. There is also a possibility that the collected shells were ground to be used as a tempering agent in pottery, hampering the accurate estimates on meat yields. However, the huge amounts of thin-shelled aquatic gastropods (*Lymnaea stagnalis*, *Planorbarius corneus*) exploited purely from the oxbow lake of Kiri-tó and found at the site must have been better suited for such purposes.
5. We have come across some perforated valves, which might have functioned as pendants, expressing the tight bond these people might have to the maritime environment, in which the cradle of these cultures resided.

The mussels gathered for food must have originated strictly from the nearby channel of the River Berettyó and not the Kiri-tó because:

1. According to the results of geoarchaeological and sedimentological investigations presented in earlier chapters (4, 5, 6, 7 and 8), the reconstructed bed of the Kiri-tó must have harboured a slightly alkaline, highly eutrophic oxbow lake with a thick littoral and floating vegetation and shallow waters of max. 1.5 m during the Neolithic. The highly eutrophic, organic-rich and oxygen-poor substrate of this lacustrine system would not have offered ideal conditions for a flourishing mussel fauna (Richnovszky 1970; Tóth and Bába 1980). According to observations carried out on the freshwater mussel fauna of Hungarian oxbow lakes by Kiss (1996), no mussels were found in waters with dense saligot or anaerobic muds. Alkalinity is also a restrictive factor in Unionid growth (Richnovszky 1970). Consequently, the mussel fauna of the Kiri-tó itself must have been rather poor.

2. The clear dominance of *Unio crassus* (Retzius 1788), otherwise missing from the sedimentological profiles of Kiri-tó, as well as the almost identical species composition of our material with that of the modern forms of the River Berettyó collected recently as part of various population ecological studies (Horváth 1955; Tóth and Bába 1980; Kiss 1996), is clear evidence of the origin of the material. The unimodal distribution of size values also points to a single population of origin.
3. We can assume that humans must have been rather choosy about the quality of their food, or at least the taste, just like we modern people are, when they chose the site for their shell fishing activities. This must have been especially true if the mussels were eaten raw as has been observed in our material. So even if sporadic collections happened initially from the Kiri-tó, these must have quickly been given up because of the unfavorable flavour of the mussels potentially collectable from its highly eutrophic environment described above.
4. According to the findings, collections must have happened by hand or via the use of fishing baskets with open bottoms and tops, and the larger older shells were favoured primarily. However, calculations of meat yields have pointed to an important issue. The species *Unio crassus*, occurring exclusively in the active channel of the River Berettyó, yielded more edible meat on the whole than the potentially dominant element of oxbow lakes, *Unio pictorum*, despite the fact that specimens of *Unio crassus* are generally smaller than those of *Unio pictorum* but with less robust shells.

Although the verification of some issues requires further investigation, we have been able to elucidate many minor details about the lives of the Neolithic community through the analysis of the shellfish material, which would have otherwise remained unnoticed in a normal simple archaeological work or would have remained the subject of mere speculation. Naturally the achievement of statistically reliable data and information necessitates a strong cooperation between archeologists and natural scientists, ensuring the retrieval of large amounts of relatively intact shell material from the cultural layers, suitable for measurements and statistical analysis.

Acknowledgements

We are greatly indebted to Alasdair Whittle and colleagues at Cardiff University for making this publication feasible. Many thanks to Árpád Kiss for sharing his findings and data on recent *Unionidae* with us, and also to Félix Schubert at the University of Szeged, Department of Mineralogy, Petrology and Geochemistry for his kind assistance in the preparation of the thin-sections.

Chapter 22

STABLE CARBON AND NITROGEN ISOTOPE ANALYSIS AND THE EVIDENCE FOR DIET AT ECSEGFALVA AND BEYOND

Jessica A. Pearson and *Robert E. M. Hedges*

Introduction

The aim of the stable isotope analysis at Ecsegfalva and from prehistoric sites in Hungary was to examine the carbon and nitrogen isotope values in a series of fauna to identify the range of habitats that may have been exploited by those living at Ecsegfalva during the Körös and to address issues such as the consumption of aquatic resources. By analysing a number of human samples from sites across the Great Hungarian Plain and comparing these to previously published isotope data from Neolithic northern Serbia and south-east Hungary (Whittle *et al.* 2002) it has been possible to identify change and continuity within human diet in this area from the Early Neolithic culture known as the Körös to the Iron Age La Tène. The fauna from Ecsegfalva provide an insight into the isotopic values that might be expected from domestic and riverine resource exploitation and these will help us to understand the nature of variation witnessed in the human samples taken from multiple prehistoric sites across the Great Hungarian Plain. In particular, the importance of non-domestic resources in Hungary during the Early Neolithic and beyond is addressed. It is hoped ultimately that isotopic analyses – at this site and those spatially and temporally related – will contribute towards a better understanding of the lifeways identities which emerge in this region.

Stable carbon and nitrogen isotope analysis and palaeodietary inquiry

Since the 1970s, stable carbon and nitrogen isotope analysis of bone and tooth collagen has been used as a method of reconstructing the diet of archaeological populations. The introduction of maize into the Americas (Vogel and van der Merwe 1977), the declining importance of marine resources at the Mesolithic-Neolithic transition in Europe (Tauber 1981) and the diet of our fossil ancestors (van der Merwe *et al.* 2003) have all been investigated with this method. More recently, it has been realised that carbon and nitrogen isotope analysis can provide useful insights into the nature of early farming (Pearson 2004) and the use of food as method of maintaining and undermining social distinctions (Richards *et al.* 1998; Pearson 2004).

Stable carbon and nitrogen isotopes in the biosphere

Carbon circulates the biosphere passing through both the organic and inorganic environment. During photosynthesis the processing of atmospheric carbon dioxide through the different photosynthetic pathways in plants (C_3 or C_4) results in different degrees of depletion of ^{13}C, relative to ^{12}C, in the molecular structures of their tissues (O'Leary 1981): C_3 plants exhibit $\delta^{13}C$ values between –34‰ and –22‰, with C_4 plants ranging in $\delta^{13}C$ values from –20‰ and –7‰.

The ratios of stable isotopes from each element are compared to an internationally agreed standard vPDB (Pee Dee Belemnite) shown in the equation below which is used to calculate carbon isotope ratios (Hoefs 1997).

$$\delta^{13}C = \left\{ \frac{(^{13}C/^{12}C)_{sample}}{(^{13}C/^{12}C)_{standard}} \right\} -1 \qquad \text{X } 1000$$

A similar equation applies for $\delta^{15}N$, where the standard is atmospheric N_2.

The uptake of nitrogen by plants, to make amino acids and ultimately, protein, may be directly from the atmosphere through symbiotic fixation (as with the members of Fabaceae (legumes) including species such as lentil, chick pea, field pea, and bitter vetch), or, more commonly, indirectly, through 'mineralised nitrogen' (nitrate or ammonium ions) from the soil. Since there is a complex dynamic turnover between soil organic nitrogen and mineral nitrogen, which is strongly influenced by water content and bioproductivity, isotopic discrimination can occur at many points. Total soil $\delta^{15}N$ has been shown to vary considerably in studies across the world ranging from –7‰ to +18‰ (Cheng *et al.* 1964; Letolle 1980), and leguminous plants often have lower $\delta^{15}N$ values than non-leguminous plants (Virginia and Delwiche 1982; DeNiro and Hastorf 1985). Further up the food chain, herbivores and carnivores assimilate these isotope values from the animals and plants they consume.

The relationship between diet and consumer tissue outlined above has been studied by early feeding experiments such as Gaebler *et al.* (1966), DeNiro and Epstein (1978; 1981) and later by scholars such as Ambrose and Norr (1993). Briefly, the carbon isotope values of animal bone collagen reflect the amount of C_3 versus C_4 plants they consume, with an additional constant fractionation of ~5‰ in $\delta^{13}C$. Additional research confirmed these findings concluding that the average nitrogen enrichment from dietary protein is 2–4‰ at each step in the foodchain (Schoeninger and DeNiro 1984; Schwarcz and Schoeninger 1991). Carbon and nitrogen isotope analyses and dietary reconstruction also assume that bone protein (collagen) isotope ratios of consumers are largely determined by dietary protein producers (Tieszen and Fagre 1993) and are largely independent of age (except nursing infants cf. Fogel *et al.* 1989; Witt and Ayliffe 2001) or sex (Lovell *et al.* 1986; Tieszen *et al.* 1989).

Methodology

Samples were taken from compact bone except for three individuals which were tooth dentine samples. Each sample was taken as a chunk of bone weighing ~ 400 mg except tooth dentine samples which were removed as powder with a drill. Samples were prepared following a modified Longin (1971) extraction protocol described elsewhere (Richards and Hedges 1999). Collagen integrity was assessed following multiple criteria set out by Ambrose (1990).

All samples were prepared and analysed at the Research Laboratory for Archaeology at the University of Oxford. Samples of bone collagen were loaded into tin capsules and combusted online to CO_2 and N_2 in a Carlo Erba CHN analyser coupled to a Europa GEO 20/20 isotope ratio-monitoring mass spectrometer (running in continuous flow mode) which measures the $\delta^{13}C$ value of CO_2 and the $\delta^{15}N$ of N_2. Nylon (Nylon 66, BDH, UK) is used as the internal reference standard material for bone collagen samples used at the Oxford RLAHA. All samples were measured in duplicate machine runs and are given drift corrected. Measurement precision is given as 0.1‰ for both $\delta^{13}C$ and $\delta^{15}N$ (Pearson 2004).

Results and discussion

A total of 68 (66 bone and 2 tooth) samples were successfully analysed from 14 sites in Hungary including 41 samples from Ecsegfalva, of these 16 were taken from data generated during radiocarbon dating chemistry. A further 27 human samples were taken from sites across Hungary. The results of these analyses are given in *Table 22.1* and in *Figs 22.1–3.*

Results from Ecsegfalva

The results from Ecsegfalva are discussed as a group first, and then discussed within the context of the much broader group of results from elsewhere in Hungary. The isotopic range for the herbivores recovered from the Ecsegfalva excavations varies in $\delta^{15}N$ from 4.78‰ to 9.74‰ and in $\delta^{13}C$ from –21.51‰ to –19.40‰ *(Fig. 22.1).* These results also indicate that no one species has an isotopic range of sufficient specificity that might aid detailed dietary reconstruction of humans from the same site. There is very little evidence to suggest that the wild and domestic resources were sourced from different environments, although the range in $\delta^{15}N$ and $\delta^{13}C$ values for the wild taxa is much narrower than is seen for the domestication caprines (including positively identified *Ovis* and *Capra*) but this may be an artefact of the small number (equids n = 2, aurochs n = 2, boar n = 2) of samples taken from the wild fauna compared with the domesticates (caprines n = 23, cattle n = 6) and should be investigated with a large sample set to provide definitive evidence. But comparing these data with those previously published from Serbia and Hungary (Whittle *et al.* 2002) indicates that the range in isotopic values for caprines from Ecsegfalva is similar to the mean and standard deviation given for smaller numbers of samples for the same genera

Table 22.1. Carbon and nitrogen stable isotope results

Lab no.	$\delta^{13}C$	$\delta^{15}N$	C:N	Species
ECSEG1	–20.67	6.42	3.34	Bos prim
ECSEG2	–20.75	6.59	3.29	Bos prim
ECSEG3	0.00	0.00	0.00	Bos prim
ECSEG4	–20.58	5.86	3.27	boar
ECSEG5	–20.33	5.07	3.31	boar
ECSEG6	–21.13	7.00	3.32	Ovis
ECSEG7	–21.51	7.67	3.28	Ovis
ECSEG8	–20.11	5.65	3.29	goat
ECSEG9	–21.43	7.18	3.21	Ovis
ECSEG10	–20.51	7.31	3.17	Ovis
ECSEG11	–20.48	8.55	3.45	Bos
ECSEG12	–20.14	5.54	3.24	Ovis
ECSEG13	–20.52	5.97	3.23	Bos
ECSEG14	–20.06	6.99	3.18	Bos
ECSEG15	–21.18	5.93	3.21	Ovis
ECSEG16	–20.22	7.24	3.23	Ovis
ECSEG17	–20.81	7.64	3.23	Ovis
ECSEG18	–21.38	7.93	3.22	Bos
ECSEG19	–20.15	7.29	3.25	Ovis
ECSEG20	–21.15	7.22	3.31	Bos
ECSEG21	0.00	0.00	0.00	large mammal
ECSEG22	–21.03	9.51	3.17	Ovis
ECSEG101	–21.44	6.88	3.23	Canis (fox?)
ECSEG102	–20.28	6.54	3.29	Equus (Half ass)
ECSEG103	–23.62	7.39	3.28	pike
ECSEG104	–22.56	8.66	3.36	pike
ECSEG105	–17.42	12.15	3.30	talpa (mole)
ECSEG106	–23.12	7.16	3.28	carp
HG1	–20.13	9.95	3.36	human
HG2	–19.96	11.50	3.32	human
HG3	–17.29	10.83	3.41	human
HG4	–16.86	10.57	3.36	human
HG5	–20.21	10.15	3.34	human
HG6	–20.01	11.27	3.31	human
HG7	–19.91	10.37	3.20	human
HG8	0.00	0.00	0.00	human
HG9	–19.72	9.87	3.25	human
HG10	–20.44	9.87	3.24	human
HG11	0.00	0.00	0.00	human
HG12	–19.65	10.36	3.19	human
HG13	–19.69	10.66	3.25	human
HG14	–20.49	11.26	3.31	human
HG15	–20.33	10.14	3.39	human
HG16	–19.10	11.09	3.20	human
HG17	–20.00	9.87	3.20	human

Table 22.1. Continued

Lab no.	$\delta^{13}C$	$\delta^{15}N$	C:N	Species
HG18	–19.79	10.21	3.45	human
HG19	–16.40	11.28	3.25	human
HG20	–16.73	10.20	3.22	human
HG21	–17.78	11.71	3.32	human
HG22	–16.81	10.57	3.23	human
HG23	0.00	0.00	0.00	human
HG24	0.00	0.00	0.00	human
HG25	–16.20	11.29	3.24	human
HG26	0.00	0.00	0.00	human
HG27	–21.07	9.75	3.24	human
HG28	–20.31	10.94	3.18	human
HG29	–19.59	9.80	3.19	human
HG30	0.00	0.00	0.00	human
HG31	–19.95	10.34	3.20	human
HG32	–19.98	9.51	3.22	human
P10871	–20.27	5.13	3.07	Equid
P10872	–19.43	7.98	3.16	Equid
P10873	–20.11	9.49	3.12	sheep/goat
P10874	–20.06	6.08	3.18	sheep/goat
P10875	–20.33	7.00	3.07	large mammal
P10876	–20.78	6.15	3.06	sheep/goat
P10877	–19.79	6.96	3.13	sheep/goat
P10878	–19.77	5.70	3.16	sheep
P10879	–19.79	5.93	3.00	sheep
P10880	–20.43	7.89	3.06	cattle
P12143	–19.84	6.30	3.18	sheep/goat
P12144	–19.93	5.86	3.20	sheep/goat
P12145	–20.14	6.56	3.21	roe deer
P12147	–19.38	4.85	3.18	sheep/goat
P12148	–19.81	5.91	3.15	sheep/goat
P12149	–20.07	6.67	3.25	sheep/goat
P12150	–21.22	6.17	3.19	large mammal
P12151	–19.85	5.69	3.25	sheep
P12154	–19.70	5.35	3.24	sheep/goat
P12142	–19.56	8.83	3.15	human

located from a number of Neolithic sites (Whittle *et al.* 2002).

The carbon values indicate that C_4 plants did not make a significant contribution to the diet of the Ecsegfalva fauna or single human. This is also confirmed in the archaeobotanical assemblage, where only a single seed each from two C_4 species represented (*Panicum miliaceum* L. and *Echinochloa crus-galli* (L.) Beauv./*Setaria pumila* (Poiret) Schultes) has been recovered (Bogaard *et al.,* chapter 23). Today, the percentage of C_4 plants contributing to the total flora count amounts to 11% in Hungary (Sage *et al.* 1999), although the actual C_4 standing biomass is probably much smaller.

The variation in nitrogen isotopes across all terrestrial fauna is striking and suggestive of food sourcing in a mosaic environment of nitrogen isotope values which may provide some clues as to the distance travelled in the acquisition of animal protein (cf. Pearson 2004). The single equid sample has nitrogen isotope values consistent with other fauna which is in contrast to other studies (Fizet *et al.* 1995) and may have some significance, but without a large sample this is not possible to evaluate. The isotopic results from boar show low nitrogen values which are thought to represent the mainly herbivorous diet of these animals in the Körös which therefore would seem not to have consumed human refuse or freshwater fish. The isotopic results of samples taken from *Bos* demonstrate high $\delta^{15}N$ values which tend to be a feature of both the wild and domestic forms of this taxon spanning Europe (Fizet *et al.* 1995) and the Middle East (Pearson 2004).

The bivariate plot of carbon and nitrogen isotopic values *(Fig. 22.1)* reveals a negative trend for caprines, which is an unusual finding in palaeodietary studies of Holocene fauna which often display a positive trend (Bocherens *et al.* 2000; Pearson 2004). In general, environmental influences which lead to additional isotopic fractionation (such as water stress) tend to cause enrichment in both isotopes. What this negative trend signifies cannot be resolved here, but agricultural practices involving manuring could be one explanation for enriched ^{15}N values. Another relevant factor may be the effect of periodic flooding, in which denitrification would alter $\delta^{15}N$ (Sebilo *et al.* 2003). Both possibilities are considered in archaeobotanical (Bogaard *et al.,* chapter 23) and

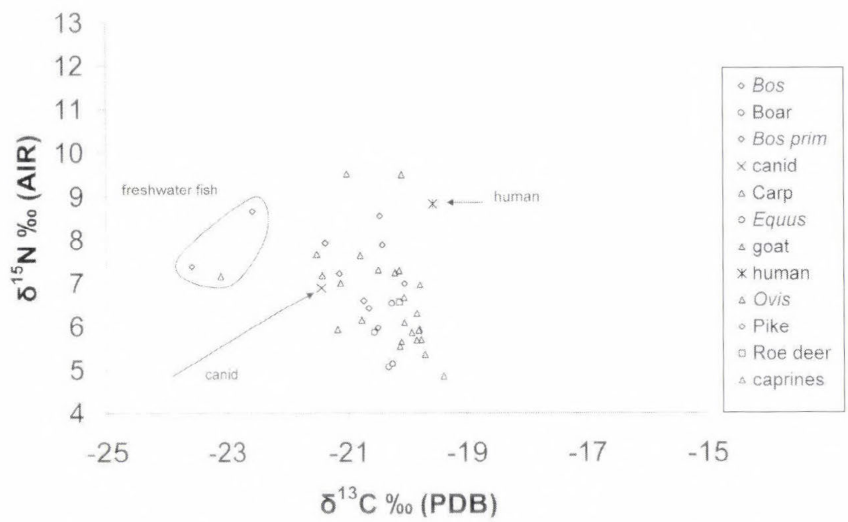

Fig. 22.1. Human and faunal $\delta^{13}C$ and $\delta^{15}N$ values from Ecsegfalva

palaeoenvironmental (Willis, chapter 6) studies at the site. We suggest that a comparison with isotopic data from other sites with similar agronomic and ecological situations would be illuminating.

Results of freshwater fish form a separate group of isotope values ranging in $\delta^{13}C$ from –23.62‰ to –22.56‰ and in $\delta^{15}N$ from 7.16‰ to 8.66‰ *(Fig. 22.1)* and it is reasonable to hope that the distinct clusters of aquatic versus terrestrial fauna will allow the significance of aquatic resources in the Early Neolithic human diet to be ascertained. Note that these values are slightly heavier in $\delta^{13}C$ compared with freshwater fish analysed from Lake Geneva by Dufour *et al.* (1999) demonstrating that the isotopic range of this resource must be characterised for each site, an aspect that has been previously overlooked (cf. Lillie and Richards 2000).

It is interesting to note that the major isotopic difference between the aquatic and terrestrial fauna at Ecsegfalva occurs within the range of *carbon* isotope values, which contrasts strongly with the picture at the Iron Gates Gorge sites of Lepenski Vir and Schela Cladovei where greatly enriched nitrogen isotope values of humans have helped identify a reservoir effect in radiocarbon dating of human bone collagen, corroborating freshwater fish consumption (Cook *et al.* 2001; Bonsall *et al.* 2004). The results of the single human sample *(Fig. 22.1)* from Ecsegfalva suggest that, for this particular individual, a significant amount of terrestrial animal protein was likely included in their diet, with some protein sourced from economic resources with lower $\delta^{15}N$ values. This implicates plant foods, but also faunal taxa with lower $\delta^{15}N$ values such as boar. But, whether this statement is true for the population that inhabited Ecsegfalva cannot be resolved here.

Considering the isotopic results from a broader region in time and space, the humans sampled from sites across Hungary *(Fig. 22.2)* indicate that in the Early Neolithic period, the diet of individuals may have included marine resources (unlikely) or C_4 plants on account of the ^{13}C enriched values (for humans from Szegvár-Táncsics utca, Csanytelek, Hódmezővásárhely-Kovács tanya and Hódmezővásárhely-Kotacpart).

However, in sites representing the later Neolithic (Vésztő-Mágor and Kisköre-Gát), these ^{13}C enriched values are not seen, but also the sample size is too small to test this statistically. At the site of Hódmezővásárhely-Kotacpart the heavier carbon isotope values are witnessed across the occupation from the Körös culture through to the Tisza culture *(Fig. 22.3)*. We would suggest that millet (or another C_4 plant?) was chosen by some for heavy exploitation from the Early Neolithic period onwards, An alternative but unlikely interpretation is that marine resource exploitation continued through to the Late Neolithic at some sites. Assuming that the samples from Ecseg-

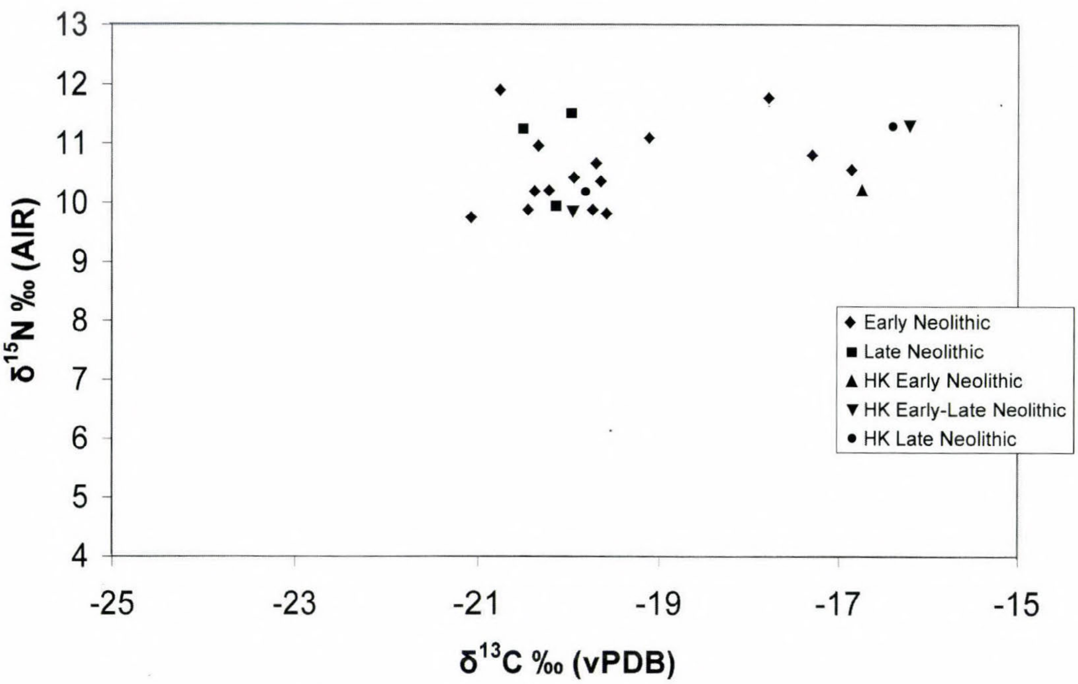

Fig. 22.2. Human $\delta^{13}C$ and $\delta^{15}N$ values from Neolithic Hungary (HK = Hódmezővásárhely-Kotacpart)

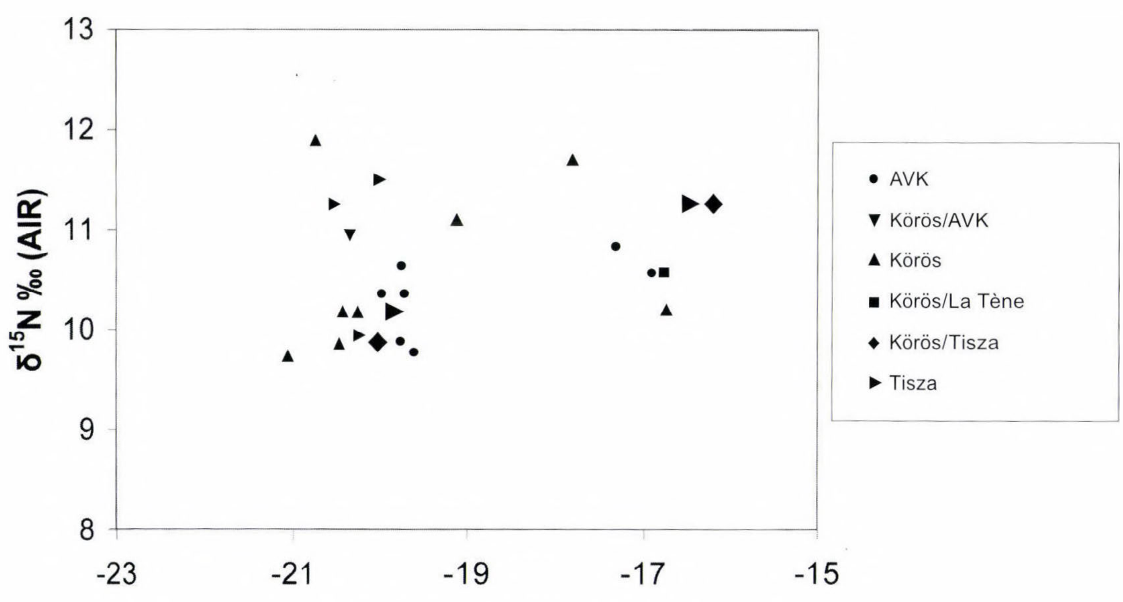

Fig. 22.3. Human $\delta^{13}C$ and $\delta^{15}N$ values from Hungary sites (results of Hódmezővásárhely-Kotacpart given as larger symbols)

falva herbivores are representative of terrestrial herbivores across Neolithic Hungary, the data shown in *Fig. 22.1* demonstrate that if C_4 plants did make a contribution to human diet, then this was achieved through direct consumption of these plants (implicating millet) and not through assimilation of values present in herbivores. However, the virtual absence of millet in the archaeobotanical assemblage of many sites across Hungary including only a single seed of millet at Ecsegfalva 23 (see Bogaard *et al.*, chapter 23, for discussion of archaeological millets in Hungary and elsewhere in Europe) does not support this hypothesis.

Finally, two of the Hungarian sites in particular seem to have lighter $\delta^{13}C$ values for humans than other sites, these include Szentpéterszeg-Körtvélyes and one of the individuals from Szarvas 8. These values are consistent with isotopic values for freshwater fish seen at Ecsegfalva (above) and Lake Geneva (Dufour *et al.* 1999), suggesting that these individuals may have incorporated this source of protein into their diet. However, the consumption of fish at other sites, especially those from other regions whose isotopic range is unknown, cannot be ruled out.

Conclusion and further work

Isotopic analyses provide most information in a context for which direct comparison can be made. That is difficult at Ecsegfalva because a general human-faunal comparison, often the most informative evidence, is hardly possible with one individual. Although some comparison can be made with other sites, and with humans and fauna from other time periods, samples are small, and there is evidently considerable variation, some of which can be explained in terms of variety of dietary protein input. We have been able to conclude that there is no major isotopic distinction between domesticates (mainly sheep) and wild fauna, although more samples are required to support the inference that wild and domestic animals fed in similar environments. The large variability within one species (sheep) at the site has been observed in other large datasets for this species (although the reasons for this are not really known). But the correlation of enriched nitrogen with depleted carbon is unusual, and we suggest that this indicates the effects of periodic flooding or that animals were feeding on cultivated soils (or both) and comparisons with other examples would be beneficial.

Although freshwater fish is scarce on the site of Ecsegfalva, the limited $\delta^{15}N$ values suggest that major fish consumption by humans may not be manifested in elevated $\delta^{15}N$ values (and also hard to detect from $\delta^{13}C$ values). The single human isotope value in fact suggests a substantial contribution of plant protein to the diet in this case. The finding of enriched $\delta^{13}C$ in humans from Szegvár-Táncsics utca, Csanytelek, Hódmezővásárhely-Kovács tanya and Hódmezővásárhely-Kotacpart, is striking, and needs explanation. Although millet consumption is perhaps the obvious one, direct evidence of millet is lacking.

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Chapter 23

ARCHAEOBOTANICAL EVIDENCE FOR PLANT HUSBANDRY AND USE

Amy Bogaard, Joanna Bending and *Glynis Jones*

Introduction

Study of the plant remains from Ecsegfalva and other Körös culture sites can potentially address major questions surrounding the nature and role of crop cultivation in the Early Neolithic of the Great Hungarian Plain. This report presents the first archaeobotanical results based on large-scale flotation at an Early Neolithic site in Hungary.

Methods

Field methods

Soil was processed using a flotation machine designed by the Environmental Archaeology Unit of York University based on a modified version of the Ankara type (French 1971). Water from a nearby drainage ditch was circulated through the flotation machine using a petrol-driven pump. Geological sieves with 1 and 0.3 mm mesh sizes retained the floating material ('flot') from each soil sample, and a c. 1 mm mesh retained the non-floating portion ('heavy fraction').

Every context excavated was sampled for processing by flotation. 'Contexts' were often arbitrary spits within major stratigraphic units (Whittle and Zalai-Gaál, chapter 9). Initially, c. 20–25 litres of soil (where available) were processed from each context; if no charred plant remains were evident at this stage, no further soil was processed. Where charred plant remains were observed in the first 20–25 litres, more soil was processed, for a total of at least 40–50 litres.

The aim of sampling was to obtain, where possible, c. 500 charred plant remains per context in order to maximise the chances that the botanical composition of each sample would accurately represent that of the original deposit (van der Veen and Fieller 1982). (In addition to the occurrence of charred plant remains, note was also taken during flotation of any fish bones in the heavy fraction of each sample. If fish bones were observed after the initial 20–25 litres, more soil was processed with a view to obtaining 500 fish bones, so long as this did not require processing of excessively large samples.) For some contexts, over 100 litres of soil were processed in order to recover at least 500 charred plant remains. For most contexts, however, the density of charred plant remains was very low (less than 1 item per litre). Obtaining 500 items, therefore, was not feasible for most contexts since it would require excessively large soil samples and would have prevented the flotation team from processing samples of every context.

Where contexts covered an extensive area, samples were taken from each square metre. If plant remains were observed after the initial processing of c. 20–25 litres from one square meter, further samples from the other square meters were processed with a view to obtaining 500 charred plant remains. In the end, the botanical contents of multiple samples deriving from the same context were amalgamated (see below) because the quantity of botanical remains in individual samples from the same context was too low to permit exploration of spatial variation within contexts.

The flot retained by the geological sieves was wrapped in kitchen paper and left to dry indoors; heavy fractions were spread out on plastic sheeting and dried in the open air. Fully dried heavy fractions were sieved with a 4 mm geological sieve. All of the > 4 mm heavy fraction was sorted for organic materials (bone, shell, charcoal and charred plant materials etc.) and artefacts. The < 4 mm heavy fractions were sorted in their entirety if any charred material (or fish bones – see note 1) were observed (in the flot or heavy fraction). Otherwise, < 4 mm heavy fractions were randomly subsampled if they exceeded c. 2 litres in volume; no less than a quarter of each < 4 mm heavy fraction sample was sorted.

Identification and quantification of the charred plant remains

All of the flot material from each sample was sorted under a low-power (x6 to x45) binocular microscope. The total charred plant material from each sample (combined flot and heavy fraction) was then sorted into crop seeds/chaff, non-crop material and wood charcoal. The volume of wood charcoal in the >1 mm size fraction of each sample (flot and heavy fraction) was measured to the nearest 0.1 ml. Crop material was identified using the crop reference collection at the Department of Archaeology, University of Sheffield and reference works such as Jacomet (1987). All other material was identified using the Sheffield seed reference collection and seed atlases (Berggren 1969; 198; Anderberg 1994). Once the wild material had been identified (where possible) to genus, a list of the Hungarian species in those genera was drawn up using *Flora Europaea* (Tutin *et al.* 1964–1993). Wild material was then identified to species where possible (see below).

Cereal grains were quantified by counting both apical and embryo ends in each sample and using the greater value. Cereal chaff was quantified by counting individual rachis internodes (of free-threshing cereals) and glume bases (of glume wheats). The seeds/fruits of wild taxa were quantified by counting embryo/apical ends (or equivalent) to yield a 'minimum number' of seeds.

Notes on crop identification

Glume wheat glume bases and spikelet forks were identified as einkorn (*Triticum monococcum* L.), emmer (*Triticum dicoccum* Schübl.) or the 'new type' of glume wheat resembling modern *Triticum timopheevi* Zhuk, recently described by Jones *et al.* (2000b) *(Fig. 23.1)*. The criteria used to distinguish the chaff of these types have been discussed in detail by Jones *et al.* (2000b). A number of terminal spikelet forks were also observed. These derive from cereal ears with a fertile terminal spikelet at the top of the ear. They do not, therefore, represent einkorn, since the terminal spikelet in einkorn is infertile (Percival 1974, 172) and is not generally preserved by charring. Terminal spikelet forks could derive from emmer, though it is also possible that they derive from the 'new type' of glume wheat.

Glume wheat grain types included einkorn grains from one-seeded spikelets, einkorn grains from two-seeded spikelets and emmer. The grain morphology corresponding to the 'new type' of glume wheat was not defined by Jones *et al.* (2000b), but the authors argue that this wheat probably has two-seeded spikelets. Recent work by Kohler-Schneider (2001, 119, plate 3; 2003, fig. 5a) on Late Bronze Age material from Stillfried, Austria, suggests that a grain shape similar to but distinct from two-seeded emmer belongs to the 'new type'. This sort of work also needs to be carried out at other sites with large assemblages of 'new' glume wheat material. At Ecsegfalva,

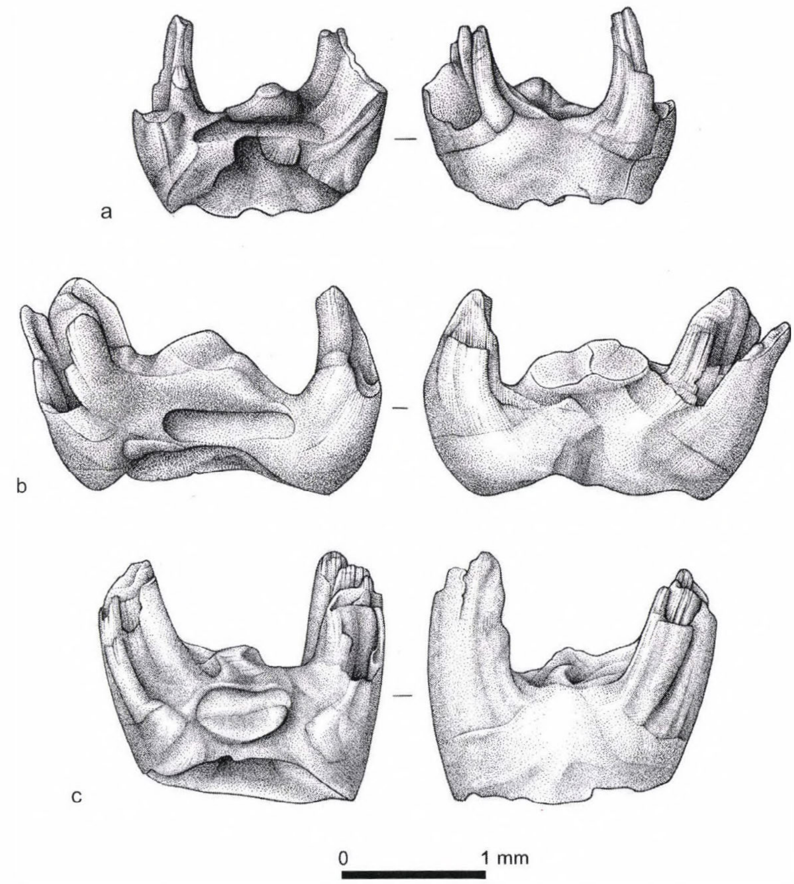

Fig. 23.1. Spikelet forks of the glume wheat types: a. einkorn (*Triticum monococcum* L.); b. emmer (*Triticum dicoccum* Schübl.); c. the 'new' type *sensu* Jones *et al.* (2000b)

no attempt was made to distinguish 'new type' grains from emmer type grains. Poorly preserved glume wheat material was identified as glume wheat indeterminate.

Within the barley category, most grains were poorly preserved and identified as indeterminate barley (*Hordeum vulgare* L.). Some grains of naked barley (*H. vulgare* var. *nudum*) were identified in one stratigraphic unit; these grains bear the transverse surface wrinkles typical of naked barley and lack the distinctive ridges characteristic of hulled barley. A single grain lacking transverse wrinkles appeared to have some of the ridges characteristic of hulled barley and was tentatively ('cf.') identified as hulled. No definite twisted grains of six-row barley (*H. vulgare* subsp. *vulgare*) were observed, but this could be due to the generally poor preservation of the grains. The eight barley rachis internodes recovered were not well preserved enough to permit a distinction between two- versus six-row barley (subsp. *distichum* versus subsp. *vulgare*), or between hulled and naked barley.

A few rachis internodes of free-threshing wheat were observed. The best specimen was a small fragment from the very top of a rachis node that appeared to have relatively clean disarticulation scars and was tentatively ('cf.') identified as bread wheat (*Triticum aestivum* L.). The other two fragments were less well preserved and/or derived from the basal part of the cereal ear, where *T. aestivum* and *T. durum* Desf are difficult to distinguish. A few wheat grains were tentatively ('cf.') identified as deriving from bread or macaroni wheat (*Triticum aestivum/durum*).

A single grain of common millet (*Panicum miliaceum* L.) was easily distinguishable from wild millets (*Echinochloa crus-galli* (L.) Beauv., *Setaria* spp.) by the wide, shallow embryo depression *(Fig. 23.2)*. With regard to pulses, a single lentil seed (*Lens culinaris*) was recovered.

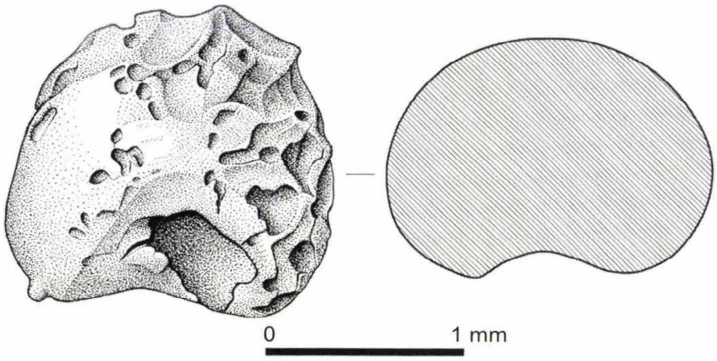

Fig. 23.2. Common millet (*Panicum miliaceum* L.)

Otherwise, a few large indeterminate legume seeds may derive from cultivated pulses.

Notes on the identification of wild taxa

The identification of common genera is discussed below. Taxa are ordered alphabetically, by family.

Caprifoliaceae:
Sambucus
Seeds of *S. ebulus* L. (Dwarf Elder) and *S. nigra* L./*racemosa* L. (Elder/Red-berried Elder) were distinguished by their shape: the seed edges of *S. ebulus* curve outwards and taper towards the base, whereas the seeds of *S. nigra/racemosa* are more parallel-sided, with an abrupt contraction at the base.

Chenopodiaceae:
Chenopodium
Chenopodium seeds were identified using criteria summarised by Jacomet *et al.* (1989). Well-preserved seeds could be identified as *Chenopodium album* L. *sensu lato* (Fat-hen) or *C. hybridum* L. (Maple-leaved Goosefoot). Species in the Hungarian flora not included in Jacomet *et al.* (1989) were available for comparison and could be variously excluded based on seed size, surface texture and/or the shape of the keel. *Chenopodium* remains of indistinct shape and surface were classified as *Chenopodium* indeterminate.
Corylaceae:
Fragments of hazelnut shell (*Corylus avellana* L.) were identified by their smooth, undulating outer surface, by 'canals' in the shell cross-section and by their shape (e.g. flat base).

Cyperaceae:
Scirpus
All but two of the *Scirpus* species in the Hungarian flora – *S. lacustris* L. *sensu lato* (Bulrush) and *S. maritimus* L. (Sea Club-rush) – could be excluded from the seeds in this category based on size (most other species are significantly smaller), shape (e.g. several other species are sharply trigonous rather than trigonous-elliptical in section) and/or surface texture (a few species are rugose rather than smooth) (Berggren 1969).

Gramineae:
Bromus
Bromus caryopses (grains) were of two types: 1. a short, broad type with rounded apex *(Fig. 23.3)*, and 2. a long slender type with pointed apex. The short/broad/rounded caryopses correspond to a group of species that occur in Hungary: *B. arvensis* L., *hordeaceus* L., *secalinus* L., *commutatus* Schrader, *racemosus* L., *japonicus* Thunb. and *squarossus* L. These species of Brome grass are quite similar ecologically (i.e. annuals with an early/short flowering period) and more specific identifications (cf. Körber-Grohne 1991) were not considered feasible. The short/broad/rounded type is referred to as *Bromus arvensis et al.*

The long/slender/pointed caryopses correspond to *B. sterilis* L. (Barren Brome); in all of the Ecsegfalva specimens, the hilum (ventral groove) extends all the way to the very tip of the apex, indicating that the species is *B. sterilis* rather than *B. tectorum* L. or *B. erectus* Hudson (Körber-Grohne 1991, Plate 22; Maier 2001, 205–6).

Bromus remains of indistinct shape were classified as *Bromus* indeterminate.

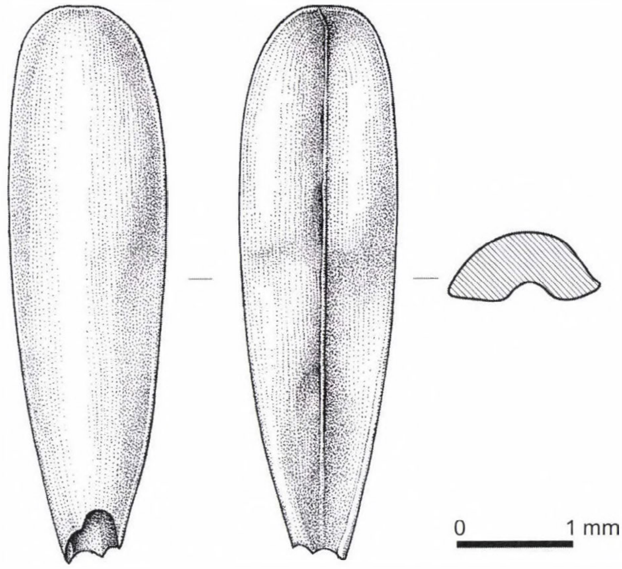

Fig. 23.3. The short/broad/rounded type of Brome grass (*Bromus*) identified as *B. arvensis et al.*

Echinochloa crus-galli (L.) Beauv./*Setaria pumila* (Poiret) Schultes
The broad-elliptical shape of the single seed in this category excludes the slim-elliptical seeds of *Setaria viridis* and *verticillata* but is consistent with *Echinochloa crus-galli* (Cockspur Grass) or *Setaria pumila* (Yellow Bristle-grass) (Körber-Grohne 1991). The seed lacked the distinctive hilum that would help to differentiate these two species (round in *E. crus-galli*, elliptical in *S. pumila*); the relative size of the embryo (slightly longer in relation to seed length in *Echinochloa*) and the shape of the apical end (blunt in *E. crus-galli*, pointed in *S. pumila*) were also ambiguous due to distortion from charring.

Poa non-*annua*

These small caryopses had a pointed apex and dorsal ridge and could derive from a range of species of *Poa* (Meadow-grass). *P. annua* L., however, could be excluded because the Ecsegfalva specimens lacked the prominent surface pattern of fruit wall cells characteristic of this species (Körber-Grohne 1991). Other species in this group are difficult to separate, especially in charred form (cf. Körber-Grohne 1991).

Leguminosae:
Small-seeded legumes
Given that there is considerable morphological overlap among small-seeded legumes in genera such as *Trifolium, Melilotus, Astragalus* and *Trigonella* (Anderberg 1994), seeds of this type were not identified more specifically.

Vicia cf. *hirsuta* DC.
The single seed fragment identified as *Vicia* cf. *hirsuta* (Hairy Tare) was distinguished from the other very small-seeded vetch, *V. tetrasperma* (L.) Schreber, by the length of the hilum relative to the circumference of the seed (i.e. one-third of the circumference in *V. hirsuta*, versus one-fifth to one-sixth in *V. tetrasperma*) (Anderberg 1994).

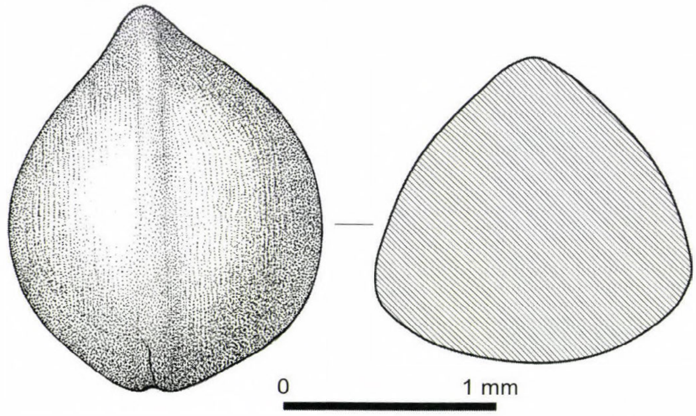

Fig. 23.4. Black-bindweed (*Fallopia convolvulus* (L.) A. Löve)

Polygonaceae:
Fallopia
Specimens in this class were distinguished from trigonous *Polygonum* species by being widest in the middle and were identified as *F. convolvulus* (L.) A. Löve (Black-bindweed) based on the surface pattern of small raised bumps *(Fig. 23.4).* A single nutlet of the same size and shape but with a smooth, glossy seed coat was identified as *F. dumetorum* (L.) J. Holub (Copse-bindweed).

Polygonum cf. *persicaria* L.
The single seed fragment identified as *Polygonum* cf. *persicaria* (Redshank) was distinguished from most species of the 'flattened *Polygonum*' type by its size and from the biconcave seeds of *P. lapathifolium* L. by its biconvex shape (Berggren 1981).

Rosaceae:
Fragaria vesca L.
The apices of seeds identified as *Fragaria vesca* (wild strawberry) were more 'hooked' than those of *Potentilla* type (Anderberg 1994).

Rubiaceae:
Galium
Seeds of *Galium* type were identified to species using the key presented by Lange (1979). The key does not include all of the species in the Hungarian flora, but these other species differed from the Ecsegfalva specimens in seed size (much smaller), seed shape (laterally compressed rather than round) and/or had a different surface cell pattern. Two species were identified: *G. aparine* L. (Cleavers) and *G. spurium* L. (False Cleavers) *(Fig. 23.5).* *Galium* remains of indistinct shape were classified as *Galium* indeterminate, while poorly preserved seed fragments belonging to genera such as *Galium* or *Sherardia* were identified as Rubiaceae indeterminate.

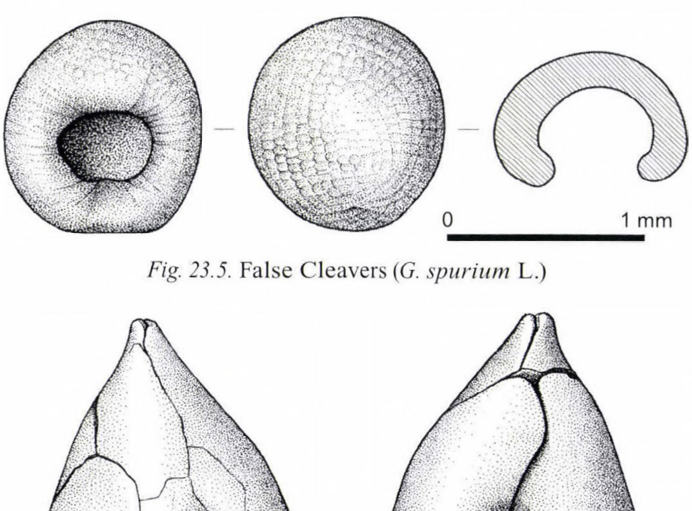

Fig. 23.5. False Cleavers (*G. spurium* L.)

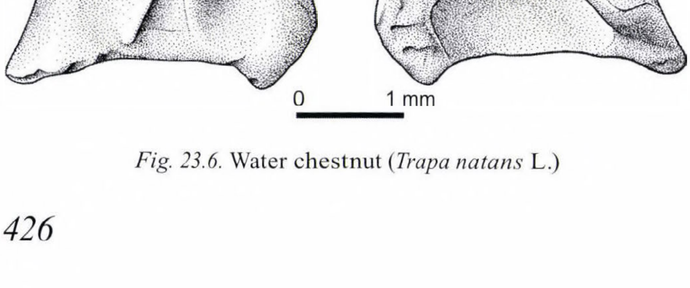

Fig. 23.6. Water chestnut (*Trapa natans* L.)

Trapaceae:
Trapa natans L.
Charred fragments of fruits with horn-like projections were recovered in a few samples. These were identified as the fruits of water chestnut by the form of their distinctive projec-

tions *(Fig. 23.6)*. (We are grateful to Alan Hall and Ksenija Borojevic for advice on this identification.)

Results

Richness and density of charred plant remains

Of the 125 contexts sampled (including six 'combined contexts' e.g. 125/129), 97 (77%) contained charred seeds/chaff. The relationship between the presence of charred seeds/chaff and wood charcoal in contexts is summarised in *Table 23.1.* Almost all contexts containing charred seeds/chaff also contained wood charcoal, perhaps reflecting the discard of seeds/chaff in domestic wood-burning fires.

Table 23.1. The relationship between the presence of charred seeds/chaff and wood charcoal per contex

	With wood charcoal	Without wood charcoal
With charred seeds/chaff	95	2
Without charred seeds/chaff	18	10

The density of charred seeds/chaff per context was low: all but ten contexts contained less than one item per litre of soil processed, and the highest density observed was c. 4 items per litre. No concentrations of remains indicating specific activities such as crop storage were preserved. The diffuse presence of charred plant remains at Ecsegfalva is reminiscent of many LBK sites across central Europe, in which pit fills tend to contain a low density of charred plant remains (e.g. Kreuz 1990; Bakels 1991). In contrast to charred plant remains in crop stores, it is likely that low density plant remains were not deposited all at once, but rather gradually, perhaps as repeated discard of domestic rubbish (see also Macphail, chapter 11, on episodic 'midden' deposition).

Amalgamation of contexts

As noted above (Methods), the contexts at Ecsegfalva were often arbitrary spits within major stratigraphic units, so that individual contexts cannot be treated as independent depositional events. Major stratigraphic units defined within each trench are summarised in *Table 23.2*; post-Körös deposits associated with the AVK (Alföld Linear Pottery culture) burial in Trench 23A contained a few plant remains but are excluded from the present discussion, which is concerned with the Körös period. Two contexts of post-Körös date contained charred plant material: the burial context (107) dating to the AVK, which contained a single seed of *Galium spurium* (False Cleavers), and a second context (132) from the same trench, of possible AVK or later date, which contained one glume wheat

Table 23.2. The major stratigraphic units per trench at Ecsegfalva

Trench	Stratigraphic unit
23A	Post-Körös deposit, including AVK burial*
	Pit complex (a series of intercutting pits or 'scoops')
23B	Upper occupation deposits
	Lower occupation deposits
	Fill of pit 390/394/395
	Fill of pit 393
	Basal layers
23C	Upper deposit
	Lower deposit

*This stratigraphic unit is excluded from the present report, which is concerned only with plant remains of Körös date

Table 23.3. Presence of different crop types in the major stratigraphic units

Crop types	No. stratigraphic units
Glume wheat material	5
Grains	*5*
Glume bases	*4*
Free-threshing wheat	2
Wheat indeterminate	5
Barley material	4
Grains	*4*
Rachis internodes	*1*
Common millet	1
Cereal indeterminate	6
Lentil	1

Table 23.4. Presence of wild taxa in the major stratigraphic units

Wild taxa **(in alphabetical order)**	No. stratigraphic units
Brassica/Sinapis	1
Bromus arvensis et al.	1
Bromus indeterminate	2
Bromus sterilis	1
Caryophyllaceae indeterminate	1
Chenopodium album	5
Chenopodium hybridum	3
Chenopodium indeterminate	2
Compositae indeterminate	1
Corylus avellana, nutshell	1
Cyperaceae indeterminate	2
Echinochloa crus-galli/Setaria pumila	1
Fallopia convolvulus	3
Fallopia dumetorum	1
Fragaria vesca	1
Galium aparine	1
Galium indeterminate	4
Galium spurium	3
Gramineae indeterminate	3
Lolium, cf.	1
Poa non-*annua*	3
Polygonum cf. *persicaria*	1
Polygonum indeterminate	1
Rubiaceae indeterminate	5
Sambucus ebulus	3
Sambucus indeterminate	1
Sambucus nigra/racemosa	1
Scirpus lacustris sl/maritimus	2
Small-seeded legumes	4
Trapa natans	2
Vicia cf. *hirsuta*	1

indeterminate grain and one *Hordeum/Lolium* grain (see also Whittle and Zalai-Gaál, chapter 9). The units in *Table 23.2* may themselves be composed of multiple lenses or layers (see Macphail, chapter 11), but these were not clearly distinguished during excavation. These major stratigraphic units, therefore, provide the best approximation available for independent depositional events. In *Appendix Table 23.1* and further analysis (below), the botanical data have been amalgamated within each major stratigraphic unit.

The crop remains

Table 23.3 summarises the presence of different crop types in the major stratigraphic units. Aside from poorly preserved cereal grains identified as wheat indeterminate or cereal indeterminate, glume wheats (in five units) and barley (in four units) are the most frequently occurring crop types. Whereas glume wheat grains and glume bases occur with similar frequency, barley occurs mostly in the form of grain. Of the other crop types, free-threshing wheat (*Triticum aestivum/durum*, rachis internodes and tentatively identified grains) was found in two units, whereas millet (*Panicum miliaceum*, single seed) and lentil (*Lens culinaris*, single seed) were recovered from one unit each.

The remains of wild plants

The occurrence of wild taxa in the major stratigraphic units is summarised in *Table 23.4.* Wild taxa at Ecsegfalva may represent arable weeds harvested and charred with crops, wild plants collected separately for food, fodder or other purposes, or seed inclusions in animal dung burned as a fuel. One of the most common wild plant seed types is *Chenopodium album* (five units), a species of ambiguous status since it is both a potential arable weed and a productive collected food (e.g. Stokes and Rowley-Conwy 2002). Samples dominated by *Chenopodium album* seeds from some LBK sites appear to reflect separate collection (e.g. Knörzer 1967; Bakels 1991; Lüning 2000, 92), while at Ecsegfalva the seeds of this species occur sporadically, mostly in association with far more abundant crop material. It will, therefore, be considered a potential arable weed. Other commonly occurring wild species include the annual plants False Cleavers (*Galium spurium*) and Black-bindweed (*Fallopia convolvulus*), occurring in three units each, both of which are potential arable weeds.

Another common wild plant type is the group of 'small-seeded legumes', which includes genera such as *Trifolium, Melilotus, Astragalus* and *Trigonella* (above, Methods). The ambiguous identification of this group makes it difficult to infer possible sources, but these seeds dominate one of the major stratigraphic units (upper occupation deposits, Trench 23B: *Appendix Table 23.I)* and may derive from sources other than harvested crops (see below).

Trees with edible fruits or nuts such as hazelnut (*Corylus avellana*) and elder (*Sambucus nigra/racemosa*), each occurring in one unit, represent collected wild plant resources. Water chestnut (*Trapa natans*), recovered from two units, is a starchy wild plant food collected from still or slow-moving water of 1–2 m depth (Clarke 1976; Karg 1996), perhaps from the Kiri-tó itself. In historical times in Hungary, water chestnuts were harvested by attaching a pelt or lamb's tail to the back of a boat and dragging it across the water to catch the thorny fruits (Karg 1996). Wild strawberry (*Fragaria vesca*) is also likely to have been collected in its own right rather than harvested in fruit as a weed of crops.

By contrast, dwarf elder (*Sambucus ebulus*) is an herbaceous perennial that has been found associated with charred crop stores in the Neolithic Alpine Foreland (Brombacher and Jacomet 1997, table 42) and will be considered a potential arable weed here. The sedge *Scirpus lacustris sensu lato/maritimus* will also be considered a possible arable weed in the wetland environment surrounding Ecsegfalva, though it could have been collected for basketry, floor covering and such like.

The botanical composition of major stratigraphic units

Figs 23.7–9 summarise the general botanical categories that occur in major stratigraphic units within each trench (see also *Appendix Table 23.I)*. The stratigraphic units considered are those containing at least 30 identifiable botanical items.

The pit complex, Trench 23A (Fig. 23.7)

This unit is dominated by cereal material: indeterminate cereal grains (36%), glume wheat glume bases (26%), glume wheat grains (14%) and barley grains (14%). Minor crop components – barley rachis internodes, free-threshing wheat rachis internodes and a single lentil – are not included in the pie chart. In terms of the abundance of remains, this is the richest unit excavated, though the overall density of remains per litre soil (c. 2 items/litre) is low, albeit higher than the average densities in the other stratigraphic units.

The barley component of the pit complex consists almost entirely of grains (barley grain:rachis ratio of c. 38:1), and so may represent cleaned barley product. The ratio of glume wheat grains to glume bases in the pit complex is c. 1:2 – the ratio in whole (one-grained) einkorn spikelets, suggesting perhaps that glume wheat spikelets are represented. Emmer and 'new type' glume wheat (both with two-seeded spikelets), however, are also present in this unit *(Appendix Table 23.I)*. The

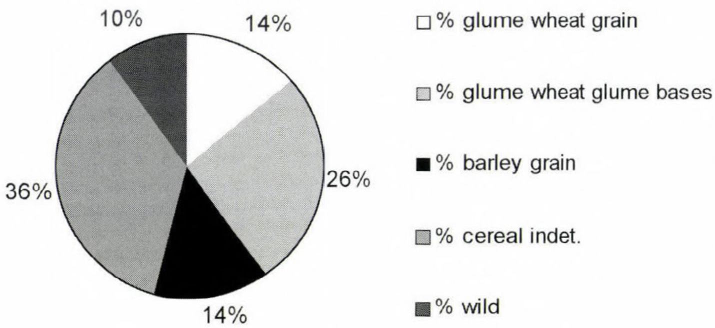

Fig. 23.7. Pie chart summarising the composition of the pit complex fill, Trench 23A

ratio expected for a mixture of one- and two-grained spikelets would be between 1:2 and 1:1. Alternatively, the glume wheat material may represent a mixture of cleaned glume wheat grain and the chaff-rich by-product of dehusking. It is also possible that the large amount of indeterminate cereal grain in the context includes glume wheat grains and that the ratio of glume wheat grain to glume bases (c. 1:2) is an underestimate.

Unfortunately, there is no straightforward way to distinguish between the two alternative interpretations of the glume wheat material in this unit. The physical types of weed seeds accompanying crop remains can form the basis of a determination of processing stage using the multivariate statistical technique discriminant analysis (Jones 1984; 1987). This technique classifies archaeobotanical samples into one of four processing categories (winnowing by-product, coarse sieve by-product, fine sieve by-product, fine sieve product) based on their similarity to ethnographic samples from each of these stages. A statistical probability is associated with the classification of each sample. Similar outcomes, however, would be expected for glume wheat spikelets, on the one hand, and a mixture of glume wheat product and by-product, on the other, since the latter is simply a 'recombination' of the two types of material generated by glume wheat dehusking and sieving. In both cases, the samples would tend to be classified as fine sieve by-product or product with low probability. In fact, using the method formulated by Jones (1984; 1987), the pit complex is classified as a fine sieve product with low probability (68%), based on the physical types of potential weed seeds in the unit (i.e. taxa identified more or less to species, excluding collected fruits/nuts: see below, *Tables 23.6–7).*

A further problem is that the glume wheat material is mixed with barley grain. It is unlikely that the glume wheat and barley were grown together as a mixed or 'maslin' crop since they have different processing requirements (cf. Charles 1998). There is no way to distinguish the weeds associated with barley from those associated with glume wheat. All in all, the most secure conclusion to be drawn regarding the processing status of the crop material in the pit complex is that it combines what were distinct crop (by-)products of barley and glume wheat. The mixed status of the charred crop material is consistent with micromorphological evidence for 'episodic' deposition in this unit (see Macphail, chapter 11). The status of the glume wheat component (whole spikelets or a mixture of grain and chaff) is unclear.

In terms of its wild species composition, the pit complex in Trench 23A contains significant numbers of seeds of several potential arable weed taxa, especially *Bromus arvensis et al., Fallopia convolvulus* and *Galium spurium (Figs 23.3–5, Appendix Table 23.1).* This potential weed assemblage is particularly important for interpreting the nature of crop husbandry at Ecsegfalva 23 (see below).

The upper and lower occupation deposits, Trench 23B (Fig. 23.8a–b)

These two units are dominated by the seeds of wild plants rather than by crop material (note a single free-threshing wheat rachis internode in the upper deposits is not included in the pie-chart, *Fig. 23.8a).* The upper deposits are particularly associated with small-seeded legumes, whereas the lower deposits contain a more even mixture of wild species (including small-seeded legumes) *(Appendix Table 23.I)*. The crop component of these deposits is too small to interpret in processing terms. The density of charred plant remains in the soil is very low (< 1 item per litre).

There is a clear contrast in composition between these occupation deposits, dominated by wild taxa, and the other units under consideration, dominated by crop material *(Figs 23.7–9)*. These occupation deposits were not as deep as the pit fills in Trenches 23A and 23B and may have been particularly affected by a cycle of wetting and drying that is destructive of charred plant remains. Poor preservation, however, should affect crop and wild plant remains alike and is unlikely to explain the contrast with other units.

It appears, therefore, that the formation of the upper and lower occupation deposits in Trench 23B involved forms of botanical deposition distinct from the other units, with occasional wild plant seeds and very little crop material. Micromorphological study of these stratigraphic units (see Macphail, chapter 11) suggests that the upper occupation layer includes evidence for burning of *in situ* open vegetation, while the lower occupation layer includes ashed stabling waste. The derivation of the charred plant remains in the upper occupation unit from burning of *in situ* open vegetation is perhaps reflected in the dominance of wild plant taxa including small-seeded legumes, while the mixture of wild plant taxa in the lower unit may reflect the seed content of burned animal dung.

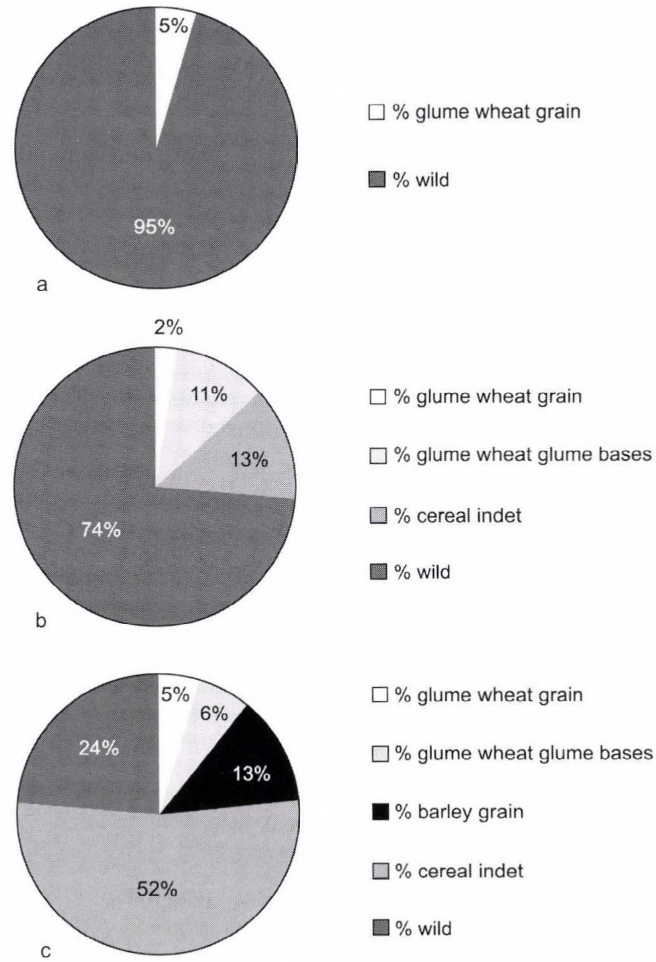

Fig. 23.8. Pie charts summarising the botanical composition of a. the upper and b. the lower occupation deposits and c. the fill of pit 390/394/395, Trench 23B

Pit 390/394/395, Trench 23B (Fig. 23.8c)

This unit is dominated by cereal grains, mostly poorly preserved and identified as indeterminate cereal (52%), with smaller proportions of barley grains (13%), glume wheat grains (5%) and glume bases (6%). In terms of crop processing, this material appears to represent mostly cleaned grain, though it is unclear whether this is mainly barley or glume wheat. Furthermore, the poor preservation of the grains may reflect charring conditions unfavourable for the preservation of chaff (Boardman and Jones 1990), so that the 'cleaned product' status of the material is uncertain. The density of plant remains is very low (< 1 item per litre soil).

The wild plant taxa in this unit include a variety of potential arable weed species (e.g. *Chenopodium album, Galium spurium, Fallopia convolvulus*) as well as collected wild plant material such as fragments of hazelnut shell and water chestnut. Using the method of Jones (1984; 1987) described above, the physical types of potential arable weed seeds in this unit were used to determine the processing stage it most resembles. The unit was classified as a fine sieve by-product with 84% probability, a result that underlines the ambiguous processing status of the unit, given that the crop material resembles fine sieve product (cleaned grain). Micromorphological study of thin sections from this unit suggests that that a variety of ashed material was deposited, including midden waste and stabling refuse.

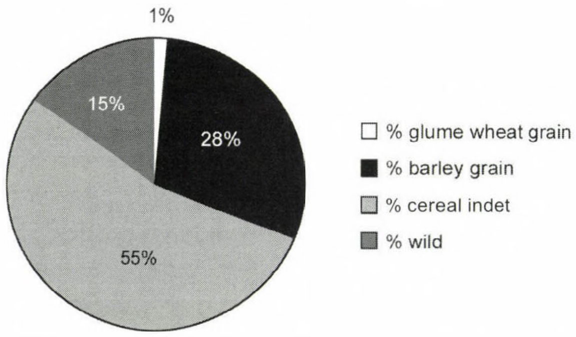

Fig. 23.9. Pie chart summarising the botanical composition of the lower deposit, Trench 23C

The lower deposit, Trench 23C (Fig. 23.9)

This apparent occupation unit is dominated by crop material, mainly indeterminate cereal grains (55%) and barley grains (28%), plus a small amount of glume wheat material and a single millet seed (the latter is not included in the pie-chart). The density of plant remains is again very low (< 1 item per litre soil). The crop material may represent cleaned grain but here again the identity of the grain is ambiguous, and chaff may be underrepresented due to unfavourable charring conditions. A single seed of *Fallopia convolvulus* in this unit may represent an arable weed. Water chestnut fruits in this unit presumably represent collected plant food.

Summary

Three of the five units considered are dominated by crop remains, mixtures of barley and glume wheat material in various stages of processing. The low density of the charred plant remains in the soil also suggests that it represents material deposited over a period of time, an inference supported by the micromorphological evidence for episodic dumping (Macphail, chapter 11). The occupation deposits in Trench 23B are dominated by wild plant seeds, perhaps from the burning of *in situ* open vegetation and/or animal dung.

Wild versus cultivated plant foods

It is not possible to extrapolate the relative dietary importance of cultivated and wild plants from their relative proportions in archaeological deposits. Wild plant foods attested at Ecsegfalva such as water chestnut and hazelnut have also been recovered from Swifterbant sites of the Rhine-Meuse delta – that is, sites associated with the acculturation of indigenous foragers into a Neolithic way of life, in a rich wetland environment (Bakels 2000). On the other hand, such wild plant foods have also been recovered from 'fully agricultural' settlements (Neolithic period and later) across Europe (e.g. Karg 1996).

Wild plant foods tend to be well represented in waterlogged detritus deposits of lakeshore settlements in the Alpine Foreland, whereas charred plant assemblages from these same sites tend to be dominated by crops and their weeds (e.g. Maier 2001). This contrast is due to the taphonomic biases inherent in different forms of preservation: waterlogging potentially preserves the full range of plant material present in a settlement, including plant materials present in smaller quantities and/or on a more strictly seasonal basis (Green 1982). The most secure inference that can be made, therefore, is that the range and abundance of wild plant foods used at Ecsegfalva 23 are probably underestimated in the charred plant assemblage.

The collected wild seeds/fruits attested at Ecsegfalva (hazelnut, water chestnut, elder, wild strawberry) ripen in the summer to autumn months. Zvelebil and Rowley-Conwy (1986) have argued that the need to harvest ripe crops would limit the availability of labour for wild plant foraging of carbohydrate-rich storable plant foods such as hazelnut. This 'scheduling problem' would be complicated further by autumn sowing of crops (see below).

Production and consumption of crops present at Ecsegfalva

Crop material may be present on an archaeological site as a result of chance factors (e.g. minor contamination of other crops) rather than deliberate cultivation of the crop. Ideally, crops present as a result of minor contamination or other chance factors should be distinguished from those deliberately cultivated. For example, Halstead (1994) uses a series of quantitative criteria to distinguish crops that were deliberately cultivated rather than merely present on Neolithic sites in Greece. These criteria are based on the abundance of crop material in samples and evidence that crops formed a major proportion of processing products and/or by-products.

At Ecsegfalva 23, einkorn, emmer and barley occur in reasonable abundance and so represent the most likely candidates for deliberate cultivation. The status of free-threshing wheat, millet and lentil is more questionable since each is represented by only one to a few items. There are no clear cases of unmixed processing products or by-products at Ecsegfalva, though barley accounts for a significant proportion of possible cleaned grain in the lower deposit of Trench 23C, and the glume wheat material in the pit complex of Trench 23A could represent spikelets.

Glume wheat chaff (glume bases) is far more frequent and abundant at Ecsegfalva than barley chaff (rachis internodes): glume wheat glume bases are present in more units than barley rachis internodes, and in the single stratigraphic unit containing barley rachis internodes (the pit complex in Trench 23A), glume wheat glume bases are far more abundant (with over 500 glume bases and eight barley rachis internodes – see *Appendix Table 23.I*). A greater presence and abundance of glume wheat glume bases compared with the rachis internodes of free-threshing cereals (e.g. barley) is widely observed in the archaeobotanical record and is probably to be explained by differences in the stage at which (glume wheat) glume bases and (free-threshing cereal) rachis internodes are removed (Hillman 1984; Jones 1985; Jones 1987). The grains of barley are released from chaff by a single threshing, which often takes place away from habitation areas and obvious sources of fire (e.g. threshing floors, barns). Barley grain is then separated from chaff by subsequent winnowing (and possible coarse sieving) at the same location. Threshing of glume wheats, on the other hand, breaks the ears into spikelets, which consist of grains tightly enclosed by glumes. Storage of glume wheats as spikelets may provide some protection against insect or rodent attack (Sigaut 1988). Final dehusking of glume wheats often takes place on a piecemeal basis, within households and near sources of fire.

These differences in the processing and archaeobotanical representation of glume wheats and free-threshing cereals complicate attempts to distinguish between producer and consumer sites based on the occurrence of by-products from early stages of processing (winnowing, coarse sieving) (Hillman 1981; 1984; Jones 1987). These by-products may not be preserved at all by charring if they are generated away from houses and sources of fire. The presence of glume wheat glume bases from dehusking, on the other hand, does not necessarily imply local production since glume wheats could be traded in spikelet form.

To summarise, a plausible explanation for the differential presence and abundance of barley and glume wheat chaff at Ecsegfalva is that it is due to the stage in processing at which these elements are removed in each case. The differential frequency of glume wheat and barley chaff, therefore, cannot be taken as a reflection of local versus non-local production. On the other hand, local production is suggested by two pieces of evidence. First, local cereal growing and/or threshing (which releases trapped pollen from cereal ears) is supported by the occurrence of cereal pollen in the Kiri-tó pollen cores, in levels contemporary with the Körös period (Willis, chapter 6). Because cereals are self-pollinating, their pollen grains do not travel far. Second, the general characterisation of Early Neolithic agriculture as lacking the ard plough and plough oxen (Sherratt 1981; Halstead 1989; Bogucki 1993) also implies local production; under these conditions, farmers would be unable to produce large crop surpluses for trade with non-producing settlements.

The crop spectrum at Ecsegfalva in comparison with other sites

Excavation of other Körös culture sites has tended not to include wet sieving or flotation. As a result, only impressions of cereals in ceramics and daub have been published from other Körös culture sites (Gyulai 2001). An explanation for the lack of cereal grain from Körös culture sites recently put forward by Gyulai (2001, 71) – that crop yields must have been very low – does not take the lack of suitable recovery techniques into account and makes the unfounded assumption of a relationship between grain yield and preservation. *Table 23.5* presents a summary of crops attested at Ecsegfalva, other Körös-Starčevo-Criş sites (in Hungary, former Yugoslavia and Romania), and Early Neolithic sites in Greece and Bulgaria.

The crops found at Ecsegfalva are variously attested at other Körös-Starčevo-Criş sites; additionally, charred remains of common pea and impressions identified as flax fibre have been observed at other sites. Cereal impressions in ceramics or daub from other Körös culture sites do not by themselves provide convincing evidence that these crops were cultivated. The charred botanical evidence from Ecsegfalva, however, does support the case for cultivation of at least some cereal crops (in particular, einkorn, emmer and barley, see above).

The occurrence of 'new type' glume wheat at Ecsegfalva (over 30 glume bases in the Trench 23A pit complex: *Appendix Table 23.1*) can be placed in the context of emerging evidence for this glume wheat crop at Neolithic sites in Anatolia and Greece (Jones *et al.* 2000b; Fairbairn *et al.* 2002) as well as at LBK (Bogaard 2004) and Lengyel (Bienek 2002) sites in central Europe. Whether or not this is a separate species, it is at least a glume wheat type distinct from the usual emmer and einkorn, and as such it underlines the central importance of glume wheat cultivation in the spread of agriculture across Europe.

The status of a find of 'millet', along with acorns and beech-nuts, from a clay-lined pit at Nosa-Biserna Obala, a Starčevo-Körös site in the Vojvodina (Garašanin 1961, 305), is uncertain *(Table 23.5)*. This find has been cited as firm evidence for early millet cultivation in the Hungarian Plain (e.g. Tringham 1971; Kosse 1979; Barker 1985) but it is not cited as a definite early find by Zohary and Hopf (2000). A recent attempt by Ksenija Borojevic (assisted by the museum curator, Ágnes Szekeres) to locate charred plant remains from this excavation at the City Museum of Subotica failed, though sherds with plant impressions of glume wheat chaff and some other small, round seeds were found (Ksenija Borojevic, *pers. comm.*). The earliest finds of millet in Europe cited by Zohary and Hopf (2000, 83) are from LBK sites in central and eastern Europe. The single seed of common millet (*Panicum miliaceum*) from Ecsegfalva 23 suggests that this species was present in the Earliest Neolithic phase in the Carpathian basin.

Common millet, a particularly hardy crop with a short growing period, does not belong to the original assemblage of crops from the Near East. It may have been domesticated in central Asia, where likely wild progenitors occur naturally; the occurrence of wild/weedy millets in Europe is a recent phenomenon according to Zohary and Hopf (2000, 83). It is intriguing that the earliest appearances of millet in Europe are associated with eastern and central Europe: as a crop requiring a spring sowing regime, millet could be interpreted as part of the temperate European adapta-

Table 23.5. The occurrence of crops at Ecsegfalva and other sites of the Körös/Starčevo/Criş cultures (later 7th – mid 6th millennium cal BC) in comparison with crops at Earlier Neolithic (early 7th – mid 6th millennium cal BC) sites in Greece and Bulgaria (based on data summarised in Renfrew 1979, Füzes 1990, Kroll 1991, Cârciumaru 1996, Borojevic 1998, Gyulai 2001, Jones *et al.* 2000b, Perlès 2001 and Kreuz *et al.* 2005).
X = charred macroremains, X* (Ecsegfalva only) = at least 30 seed/chaff items in a single stratigraphic unit, I = impressions in ceramics/daub, X? = identification uncertain ('cf.'); for the Starčevo-Körös millet (Garašanin 1961), see text for comment

	Ecsegfalva	**Körös**	**Starčevo(-Körös)**	**Criş**	**Greece and Bulgaria**
Einkorn	X*	I	X	I	X
Emmer	X*	I	X	I	X
'New' glume wheat	X*				X
Barley	X*	I	X (hulled+naked)		X (hulled+naked)
Free-threshing wheat	X		X		X
Common millet	X		X?		X?
Lentil	X		X		X
Common pea			X		X
Flax		I (fibre)			X
Spelt			X?	I	
Bitter vetch					X
Grass pea					X
Chick pea					X

tion of early Mediterranean agriculture (cf. Kosse 1979, 128; Halstead 1989). Sporadic finds such as the single seed from Ecsegfalva, however, are insufficient to demonstrate cultivation, and the possibility remains that this species occurred as a weed of other crops at the site.

In comparison with Körös-Starčevo-Criş sites, a broader spectrum of crops has been recovered from Early-Middle Neolithic sites in Greece and Bulgaria, where the pulse crops bitter vetch, grass pea and chick pea are found in addition to einkorn and emmer, hulled and naked barley, free-threshing wheat, lentil and common pea. It is possible to infer from the available evidence *(Table 23.5)* that there was a progressive narrowing of the crop spectrum from the southern through to the northern Balkans. This could be an artefact of the lack of flotation on Körös-Starčevo-Criş sites, though much of the Greek and Bulgarian data have also largely been recovered without systematic flotation and sieving (Halstead 1994, 200).

It is possible that some of the pulse crops grown in Greece and Bulgaria during the Earlier Neolithic were absent further to the north and west for climatic reasons. Grass pea, bitter vetch and chick pea are strictly Mediterranean crops in Europe today, in contrast to common pea and lentil, which are also grown further north (Zohary and Hopf 2000, 94, 101, 108, 116, 119). It is in the zone of 'flat' sites of the Körös-Starčevo-Criş complex that problems have been inferred with the cultivation in a temperate climate of crop strains adapted to Mediterranean conditions (Bogucki 1988; 1996; Halstead 1989). Halstead (1989) has previously suggested on this basis that crop production played a lesser role in communities of the Körös culture than in those of the southern Balkans and Greece. Perhaps the wide variety of non-crop resources exploited at Körös-Starčevo-Criş sites was in part a reaction to the relatively restricted range of viable crops. The evidence for fowling and fishing on Körös culture sites (Tringham 1971; Kosse 1979; Barker 1985) contrasts with a lack of such evidence from Neolithic sites in the southern Balkans and Greece (Halstead 1989).

Halstead (1989) and Kreuz *et al.* (2005) have emphasised that the range of well attested crops in the LBK (emmer, einkorn, common pea, lentil, flax) is strikingly narrower than that of Neolithic sites in Greece and Bulgaria. The data currently available suggest that a relatively narrow crop spectrum is also characteristic of the Körös-Starčevo-Criş complex *(Table 23.5)*, though the ample evidence of barley at Ecsegfalva, together with (limited) evidence for naked wheat, suggests that the cereal spectrum was broader than that of the LBK, an observation which has been made for the Körös-Starčevo-Criş sphere as a whole (Kreuz *et al.* 2005).

The occurrence of wild taxa at Ecsegfalva and comparison with other sites

Aside from the range of wild taxa from Ecsegfalva, very little evidence for non-crop taxa has been published for Körös culture sites. Previously, two fruit/nut species have been recovered as charred macroremains (hazelnut, Cornelian cherry) (Gyulai 2001) and two potential arable weed taxa (*Bromus* sp., *Lathyrus* sp.) are known as ceramic impressions from Szeged-Gyálarét (Hartyányi and Nováki 1975a). Impressions of *Aegilops* cf. *speltoides* are reported from the Criş culture site of Glăvăneşti Vedu in Romania (Cârciumaru 1996). Charred seeds of wild plants at the southern Starčevo culture site of Anza included four potential arable weed species: *Bromus hordeaceus*, *Fallopia convolvulus*, *Polygonum aviculare* and *Utricularia vulgaris* (Renfrew 1976).

The list of potential weed taxa identified more or less to species at Ecsegfalva 23 closely resembles the spectrum of wild taxa commonly recovered from LBK sites across central and western Europe (e.g. Knörzer 1971; Willerding 1980). As shown in *Table 23.6,* almost all of the potential weed species at Ecsegfalva occur as probable arable weeds in weed-rich archaeobotanical samples from Neolithic sites in the loess belt (Bogaard 2002); the exception is *Scirpus lacustris sensu lato/maritimus*.

It is striking that most of the potential weeds at Ecsegfalva also occur at sites of the Earliest LBK in central Europe *(Table 23.6)*. The majority of these species do not have natural habitats in central Europe today and appear to have been introduced by Neolithic farmers ('anthropochores') (Kreuz 1993; Kreuz *et al.* 2005). The present-day distribution of anthropochores attested in the

Table 23.6. The occurrence of the potential weed taxa (identified more or less to species) from Ecsegfalva in weed-rich samples from Neolithic sites in the loess belt (Bogaard 2002) and at sites of the Earliest LBK (Kreuz 1993; Kreuz *et al.* 2005). Status in central Europe: introduced = lacking natural habitats in central Europe; native = having natural habitats in central Europe (based on Oberdorfer 1994; Kreuz *et al.* 2005)

Ecsegfalva potential weed taxa	Neolithic loess belt	Earliest LBK	Status in central Europe
Bromus arvensis et al.	x	(x)	introduced
Bromus sterilis	x		introduced
Chenopodium album	x	x	introduced
Chenopodium hybridum	x	x	introduced
Echinochloa crus-galli/Setaria pumila	x	(x)	introduced
Fallopia convolvulus	x	x	introduced
Fallopia dumetorum	x	x	native
Galium aparine	x	x	introduced
Galium spurium	x	x	introduced
Polygonum cf. persicaria	x		introduced
Sambucus ebulus	x	x	native
Scirpus lacustris sl/maritimus			native
Vicia cf. hirsuta	x	x	introduced

Earliest LBK extends to the east and south of the LBK area (Kreuz 1990, 147–48; 1993). On this basis, Kreuz (1990, 148; 1993) argues that they reflect a westward migration of LBK farmers from areas such as western Hungary.

There is no *a priori* reason why the 'movement' of arable weed species, any more than that of domesticated crops and animals, should necessarily reflect the migration of people. It is possible that arable weeds, together with crops, were spread through exchange (cf. Dennell 1983, 164–65). The similarity in weed flora between Ecsegfalva 23 and the Earliest LBK, however, does clarify certain aspects of the relationship between Körös culture and LBK arable farming. First, the marked similarity in weed flora lends further support to the idea that crops (and arable weeds) of the Earliest LBK were derived from those of earlier farmers in the Hungarian Plain. It has recently been suggested that the specific area of transmission is Transdanubia (Gronenborn 1999; Bánffy 2000a). Interestingly, a published LBK assemblage from this region includes potential weed taxa occurring at both Ecsegfalva and Earliest LBK sites: *Bromus*, *Galium* and *Fallopia* seeds were found in a rich deposit of charred emmer and einkorn at the site of Pári-Altäcker dűlő (Hartyányi and Nováki 1975a). Second, because the floristic composition of weed floras is sensitive to ecological conditions and changes in crop husbandry practices (e.g. timing and method of sowing, tillage, weeding, manuring and so on), continuity in weed floras from the Körös to the LBK culture suggests some degree of continuity in husbandry practices.

The reconstruction of arable growing conditions and hence crop husbandry practices based on the potential weed taxa from Ecsegfalva is considered further below.

Ecological analysis of potential arable weeds

The potential weed assemblage at Ecsegfalva 23 can provide insight into crop husbandry practices based on the ecological requirements and behaviour of the constituent species. Before assessing these implications, however, it is necessary to consider the impact of crop processing on weed composition. Crop processing systematically alters the composition of arable weed assemblages associated with crop remains (Hillman 1984; Jones 1984; 1987). Most seriously, crop processing may affect the way in which harvested crops and weeds reflect crop husbandry practices (Jones 1992). This problem is particularly acute for inferences regarding crop sowing time: weed seeds accompanying cleaned grain products tend to indicate autumn sowing, whereas weed seeds accompanying by-products tend to indicate spring sowing (Bogaard *et al.* 2005). The strongest evidence for crop sowing time, therefore, is provided by crop products and by-products that contradict these biases (e.g. crop by-products indicative of autumn sowing). Other inferences, regarding the permanence of arable plots and the intensity of cultivation, appear to be less affected by crop processing (Bogaard 2002; Bogaard *et al.* 2005).

Only one of the major stratigraphic units at Ecsegfalva contains a reasonable number of potential arable weed seeds (i.e. at least 30) as well as abundant crop material – the pit complex in Trench 23A *(Table 23.2; Appendix Table 23.I)*. The potential weed composition of this unit, as well as the total assemblage of potential weed taxa from the site, will be used to infer the nature of crop husbandry. While the arable origin of the species listed in *Table 23.6* cannot be proven, the unusual abundance of potential weed taxa together with crop material in the pit complex of Trench 23A suggests that they mostly arrived by the same route. *Table 23.7* summarises the basic ecology of the potential weed taxa at Ecsegfalva 23. Major aspects of the crop-growing environment are considered in the following sections.

A recent analysis of weed survey data from the Hambach Forest experiment (Meurers-Balke and Lüning 1990) suggests that the weeds characteristic of shifting cultivation are perennials, especially woodland perennials (Bogaard 2002). This observation is supported by data from a second, ongoing experiment on shifting cultivation, at Forchtenberg near Stuttgart (Rösch *et al.* 2002, table 4), where the arable weed seeds harvested with crops grown in a shifting cultivation regime were dominated by perennials, including woodland perennials.

Table 23.7. The ecology of Ecsegfalva potential weed taxa. Phytosociological class is given for character species only (Oberdorfer 1994), habitat information follows Ellenberg *et al.* (1992) and flowering onset/length is based on flowering data for Germany from Rothmaler (1995)

Ecsegfalva potential weed taxa	Life history	Phytosociological class	Habitat	Flowering onset/length
Bromus arvensis et al.	annual		ambiguous	early/short
Bromus sterilis	annual	Chenopodietea	disturbed	early/short
Chenopodium album	annual	Chenopodietea	disturbed	late
Chenopodium hybridum	annual	Chenopodietea	disturbed	medium/intermediate
Echinochloa crus-galli/Setaria pumila	annual	(Chenopodietea)	disturbed	late
Fallopia convolvulus	annual	Secalietea	disturbed	late
Fallopia dumetorum	annual	Artemisietea	disturbed	late
Galium aparine	annual	Artemisietea	disturbed	medium/intermediate
Galium spurium	annual	Secalietea	disturbed	long
Polygonum cf. persicaria	annual	Chenopodietea	disturbed	late
Sambucus ebulus	perennial	Artemisietea	disturbed	early/short
Scirpus lacustris sl/maritimus	perennial	Phragmitetea	littoral	early/short
Vicia cf. hirsuta	annual	Secalietea	disturbed	early/short

Table 23.8. Proportions of annual and perennial species among potential weed taxa in the pit complex fill (Trench 23A), based on number of seeds and number of taxa

	Seeds		Taxa	
	No.	%	No.	%
Annuals	176	99	9	90
Perennials	1	1	1	10

Of the 13 potential weed species at Ecsegfalva, 11 are annuals, and none of these species is classified phytosociologically as being characteristic of woodland plant communities *(Table 23.7)*. In fact, most of the potential weed taxa at Ecsegfalva are associated with frequently disturbed ground *(Table 23.7)*. The proportions of annual versus perennial taxa in the pit complex of Trench 23A are summarised in *Table 23.8*. The dominance of annual taxa in terms of both seeds (99%) and numbers of taxa (90%) in the pit complex, the greater number of annual taxa generally at the site and the absence of any woodland species *(Table 23.7)* offer strong evidence against shifting cultivation. Though the woodland surrounding Ecsegfalva was probably more open than that of the Hambach Forest (see Willis, chapter 6), it is to be expected that shifting fields in open parkland would be dominated by perennials associated with the plant communities cleared to make way for cultivation, including grassland perennials as well as those of woodland.

The scale and intensity of cultivation

Charles *et al.* (2002) have presented an ecological and statistical method that can be used to classify archaeobotanical samples as deriving from small-scale/intensive or large-scale/extensive husbandry regimes based on their weed content. Using this approach, an archaeobotanical weed assemblage can be compared to modern weed floras developed in intensively hand-cultivated plots and in extensively ard-cultivated plots in Evvia, Greece (Jones *et al.* 1999; 2000a). Weed ecological characteristics that predict species' response to soil fertility and disturbance, the two major components of cultivation intensity (Jones *et al.* 2000a), form the basis of this comparison.

Discriminant analysis of the modern intensively and extensively cultivated plots has resulted in the extraction of a discriminant function that successfully distinguishes between the two groups of plots (Jones *et al.* 2000a; Charles *et al.* 2002). It should be noted that the discriminant function presented here differs somewhat from that (based on semi-quantitative data) in Charles *et al.* (2002). This is because the functional attribute data used for the Evvia (and Ecsegfalva 23) weed species incorporate all available data from across Europe, whereas that presented by Charles *et al.* (2002) was based on functional attribute measurements from Evvia alone. This function was used to classify the weed assemblage from the pit complex in Trench 23A at Ecsegfalva 23 as deriving from either intensive or extensive cultivation. In order to apply this method to the weed assemblage from the pit complex in Trench 23A, combined ecological data for *Bromus arvensis, B. hordeaceus* and *B. secalinus* were used to represent the '*Bromus arvensis et al.*' category. Ecological data for *Fallopia dumetorum* were unavailable, and so this taxon was excluded from the analysis. Finally, the taxon *Echinochloa crus-galli/Setaria pumila* was excluded as being too general an identification.

SPSS for Windows Release 10.0.7 was used to carry out the analysis. As the quantitative weed data for the modern study (quadrat counts out of 10 per field) and the archaeobotanical sample (seed counts) are not directly comparable (Charles *et al.* 2002; Bogaard 2004), the discriminant analysis was carried out on the basis of semi-quantitative (presence/absence) weed data.

The results of the analysis are clear: the discriminant function classified the weed assemblage from the pit complex in Trench 23A as deriving from intensive garden cultivation with high probability (> 99%). While it is not impossible that this result is affected somehow by the mixed crop processing status of the unit (see above), this aspect of crop husbandry does not appear to be severely biased by the effects of crop processing on the weed flora (Bogaard *et al.* 2005).

Crop sowing time

As noted earlier, the inference of crop sowing time from archaeobotanical weed evidence is significantly affected by biases introduced by crop processing (Bogaard *et al.* 2005). Since the crop material from the pit complex represents a mixture of barley and glume wheat at different processing stages, the associated weeds are unlikely to provide any clear indication of crop sowing time for either crop type. The ecological and statistical method presented by Charles *et al.* (2002) for classifying archaeobotanical samples as deriving from autumn- or spring-sown crops, therefore, has not been applied. Nevertheless, it should be noted that some of the potential weed taxa at Ecsegfalva begin flowering early and continue flowering for only a short period of time *(Table 23.7)*, characteristics associated with autumn-germinating weeds typical of autumn-sown crops (Bogaard *et al.* 2001). While it is possible that a few autumn-germinating weeds might persist in spring-sown fields, intensive cultivation imposes its own bias against autumn-germinating weeds, which tend to be removed by weeding during the crop-growing season. It is unlikely, therefore, that autumn-germinating weeds would survive under a combined regime of spring sowing and intensive cultivation. In other words, the fact that some autumn-germinating taxa evidently survived suggests that there was some autumn sowing of cereals at Ecsegfalva 23.

Discussion

Some time ago, Kosse (1979, 129) suggested, on the basis of ethnographic data from the Hungarian Plain, that crop fields tend to be permanent where good dry land is limited. It appears that this generalisation is applicable to Ecsegfalva in the Körös period; seasonal flooding would have reduced the amount of high dry land available (Gillings, chapter 3; Molnár and Sümegi, chapter 4; Sümegi and Molnár, chapter 5) and cultivation areas appear to have been permanent or 'fixed' rather than shifting. On the other hand, high dry land does not appear to have been excessively limited (Bogaard *et al.* in preparation; Gillings, chapter 3), and other social factors, not unique to Ecsegfalva 23 or more generally to the Körös culture zone, probably constrained the scale of cultivation. In fact, it is likely that the scale of cultivation was restricted less by seasonal flooding than by household labour. The area that a farming family can hand-cultivate and harvest is up to *c.* four hectares per year (Halstead 1995). If crop yields per unit area are high, as would tend to be the case in an intensive cultivation regime, a farming family can subsist on as little as one or two hectares (see discussion in Bogaard 2004, 41–44, table 2.2). The potential arable weed assemblage recovered at Ecsegfalva 23 points to intensive cultivation of small plots, involving practices such as manuring/middening and hand-weeding that would maximise yields in restricted household cultivation areas.

The location of these cultivation areas was probably quite close to the household or households occupied at Ecsegfalva 23. Ethnoarchaeological work in Evvia, Greece (Jones *et al.* 1999) has shown that cultivation intensity is correlated with distance between plots and households: the closer the plots, the more intensively they are managed. The figure of 500 m has been cited as a maximum distance within which intensive manuring (i.e. spreading of collected manure from stalls or pens) is feasible (Paul Halstead, field notes from northern Greece). The work of Mark Gillings (chapter 3) and others (e.g. Kosse 1979, 129) has shown that Körös culture sites tend to be located on the locally highest parts of the landscape in order to avoid seasonal flooding. It is likely that crop plots were also located on these higher patches of ground because autumn-sown crops – tentatively inferred from the presence of autumn-germinating potential weed taxa at Ecsegfalva (above) – would be damaged by flooding in winter (due to ice melt) and early spring (the so-called 'green flood' in April). Autumn sowing, therefore, suggests that Körös farmers did not rely on the supposed inherent fertility of the flooding zone (Sherratt 1980), a point which emphasises the role of intensive labour inputs (tillage/weeding, manuring/middening: cf. Bogaard 2004).

Intensive garden cultivation at Ecsegfalva also has implications for the nature of occupation. It reflects heavy investment in a particular place, the labour-intensive inputs creating cultivation plots that could potentially be used for decades or centuries without exhaustion. This is not to say that the entire community was tethered 'to the spot' the year round but rather that there was a more or less sedentary presence of at least part of the community near crop growing areas, carrying out tasks such as periodic weeding during the crop growing season and protecting plots and crop stores. At busy times in the cultivation cycle (tillage/sowing, harvesting), the whole community would be needed. Perhaps women and children bore the daily responsibility for the protection and tending of cultivation plots, as in recent horticultural societies (Brown 1978, 78–85; Watson and Kennedy 1991; Ingold 1996). Such a scenario may be reflected in a bias towards female and child burial on Körös culture sites (see also Bogaard *et al.* in preparation).

It is important to consider how the small-scale and intensive nature of crop husbandry at Ecsegfalva as reconstructed from the archaeobotanical evidence sits with other forms of evidence for land use and animal husbandry at the site. In terms of seasonality, Bökönyi (1972b) suggested year-round occupation of certain Körös culture sites based on the spectrum of bird species represented and the age distribution of the mammalian fauna. The seasonality evidence from Ecsegfalva is also consistent with occupation more or less year-round. The skeletochronological evidence for seasonal culling of caprines (Pike-Tay, chapter 16) suggests culling in winter and early spring, an observation underlined by the presence of neonatal sheep remains (Bartosiewicz, chapter 14). The bird bone assemblage (Gál, chapter 19) is dominated by early spring-late autumn species but also includes a winter visitor (Goosander) and so would be consistent with year-round occupation.

In terms of the scale and intensity of animal husbandry at Ecsegfalva, small-scale herding of animals mostly kept in the vicinity of the site and surrounding arable plots would be consistent with small-scale and intensive garden cultivation. Extensive, large-scale pastoralism, featuring long-distance movements of herds, tends to be associated with similarly large-scale and extensive plough-based arable farming (Halstead 1987; 1996; 2000). In this sort of system, manure is 'lost' due to transhumant movements of herds, and inputs per unit area such as weeding and manuring are low in extensive arable fields.

Several lines of evidence (Bartosiewicz, chapter 14; Mainland, chapter 17; Macphail, chapter 11; Pike-Tay, chapter 16) point to small-scale and intensive animal husbandry at Ecsegfalva. First, the zooarchaeological analysis by Bartosiewicz (chapter 14) suggests that the principal livestock species was sheep. Sheep are grazers rather than browsers and so are effectively confined to open ground, an obvious component of which would be arable land, on to which sheep could be folded at various points in the year. Second, the skeletochronological analysis by Pike-Tay (chapter 16) suggests an emphasis on the culling of two- and three-year old sheep, consistent with a strategy of raising caprines for meat (Payne 1973). The absence of evidence for intensive dairying (*sensu* Payne 1973) suggests that herding was a relatively small-scale activity integrated with more productive arable farming (Halstead 1981; 1989; 1998; Legge 1981). The detection of dairy fat residues on potsherds from Ecsegfalva (Craig *et al.*, chapter 18) shows that milk was used, but the absence of evidence for high infant mortality suggests that milk use formed part of a 'mixed purpose' herding strategy (cf. Halstead 1998). Third, the analysis of microwear patterns on a sample of 16 sheep/goat mandibles by Mainland (chapter 17) indicates high soil ingestion and overgrazing, a finding consistent with the confinement of animals to penned areas. Fourth, Macphail's analysis of soil micromorphology (Macphail, chapter 11) suggests that there is evidence of 'stabling' refuse in several areas, implying that animals were kept on the site, that dung was concentrated in certain areas and that this concentrated dung was available for spreading on nearby cultivation plots. In combination, therefore, the bioarchaeological and soil micromorphological data from Ecsegfalva provide compelling evidence for small-scale and intensive mixed farming. Moreover, organic nitrogen levels reported by Willis (chapter 6) point to eutrophication of the Kiri-tó during the Körös period, possibly an effect of fertilisation of the surrounding slopes.

The reconstruction of fixed cultivation plots managed using intensive techniques echoes similar conclusions from recent work on LBK crop husbandry (Bogaard 2004). The implication is that, in these respects at least, Early Neolithic crop husbandry in the eastern Hungarian plain resembled later practice across the loess belt of central Europe. This is not to argue that the Körös culture and LBK economies were similar in other respects; the faunal data indicate that they differed significantly, with emphasis on sheep/goat in the former and cattle in the latter. It is also not necessary to conclude from the archaeobotanical evidence that LBK farmers were biologically related to Körös culture farmers. What *is* clear is that crop cultivation involved a considerable degree of sedentism, in contrast to the seasonal mobility often envisioned for Mesolithic hunter-gatherers in much of central Europe (e.g. Jochim 1976; but see Zvelebil 2000). Whether or not the Körös-Starčevo-Criş phenomenon represents the adoption of farming practices by indigenous hunter-gatherers (e.g. Greenfield 1993; Bogucki 1996; Whittle 1996), the creation and maintenance of fixed, intensively cultivated areas in the Early Neolithic should play a part in our understanding of the transition.

Acknowledgements

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Appendix

Appendix Table 23.1. Summary of charred plant remains from the major stratigraphic units

	23A Pit complex	23B Basal layers	23B Upper occupation deposits	23B Lower occupation deposits	23B Fill of pit 390/394/395	23B Fill of pit 393	23C Lower deposit	23C Upper deposit
Volume soil (l)	1381	7	821.5	639	1368.2	98	377	65
Charcoal volume (ml)	21.4	0.1	3.8	4.3	72.9	0.8	37.7	13.2
Density (charred seeds and chaff/l soil)	1.6	0.1	0.1	0.1	0.2	0.0	0.2	0.1
CEREAL GRAIN								
Triticum monococcum, one-grained	7				1			
Triticum monococcum, cf. one-grained	10							
Triticum monococcum, two-grained	3							
Triticum monococcum, cf. two-grained	18							
Triticum cf. *monococcum*	1							
Triticum dicoccum	8							
cf. *Triticum dicoccum*	36		1					
Triticum monococcum/dicoccum	64		1	1	2		1	
Triticum monococcum/dicoccum/spelta	150				8			
Triticum cf. *durum/aestivum*	3							
Triticum dicoccum/durum/aestivum	3							
Triticum indeterminate	447	1		1	41		2	
cf. *Triticum* indeterminate					3			
Hordeum vulgare var *nudum*	7							
Hordeum vulgare cf. var *nudum*	23							
Hordeum vulgare cf. hulled	1							
Hordeum vulgare indeterminate	278				30		21	1
cf. *Hordeum vulgare* indeterminate	2				1		1	
Hordeum/Triticum	13							
Panicum miliaceum							1	
Cereal indeterminate	309			5	83	1	40	5

Appendix Table 23.1. Continued

	23A Pit complex	23B Basal layers	23B Upper occupation deposits	23B Lower occupation deposits	23B Fill of pit 390/394/395	23B Fill of pit 393	23C Lower deposit	23C Upper deposit
CEREAL CHAFF								
Triticum monococcum glume bases	13							
Triticum cf. *monococcum* glume bases	8							
Triticum dicoccum glume bases	67				1			
Triticum cf. *dicoccum* glume bases	5							
Triticum dicoccum/'new type' glume bases	117							
'New type' glume bases	27				6			
cf. 'New type' glume bases	6				2			
Triticum monococcum/dicoccum/spelta glume bases	323			3	5		1	
Terminal glume bases (no ventral scar)	10			2				
Triticum cf. *aestivum* rachis	1							
Triticum cf. durum/aestivum rachis	1							
Triticum cf. *durum/aestivum* basal rachis			1					
Hordeum vulgare indeterminate rachis	8							
PULSES								
Lens culinaris	1							
Large legume indeteterminate			1	1	5			
WILD SPECIES (by family, in alphabetical order)								
Sambucus ebulus	1				2	1		
Sambucus nigra/racemosa	6							
Sambucus indeterminate					1			
Caryophyllaceae indeterminate				2				
Chenopodium album	9		1	4	15	1		
Chenopodium hybridum	4			1	3			
Chenopodium indeterminate	9		1					
Compositae indeterminate				2				
Corylus avellana, nutshell					< 1 ml frags			
Brassica/Sinapis					1			

Appendix Table 23.1. Continued

	23A Pit complex	23B Basal layers	23B Upper occupation deposits	23B Lower occupation deposits	23B Fill of pit 390/394/395	23B Fill of pit 393	23C Lower deposit	23C Upper deposit
Scirpus lacustris sl/maritimus			1		2			
Cyperaceae indeteterminate				1	1			
Bromus arvensis et al.	64							
Bromus sterilis/tectorum	6							
Bromus indeterminate	13				2			
Echinochloa crus-galli/Setaria pumila	1							
Poa non-*annua*	1		4	1				
cf. *Lolium*	1							
Gramineae indeterminate	5		2		1			
Vicia cf. *hirsuta*					1			
Small-seeded legumes	1		32	13	4			
Fallopia convolvulus	28							
cf. *Fallopia convolvulus*	2				2		1	
Fallopia dumetorum	1							
Polygonum cf. *persicaria*					1			
Polygonum indeterminate	2							
Fragaria vesca				2				
Galium aparine	9							
Galium spurium	52			3	1			
Galium indeterminate	10		2	1	11			
Rubiaceae indeterminate	3		1	2	7			1
cf. Rubiaceae indeterminate				1				
Trapa natans					3		11	
Nutshell or fruitstone				< 1 ml frags	< 1 ml frags	< 1 ml frags		
Possible fruit flesh			< 1 ml frags		< 1 ml frags		< 1 ml frags	

Chapter 24

THE SILICA SKELETONS FROM THE ANTHROPIC DEPOSITS

Marco Madella

Introduction

Phytoliths are microscopic bodies of opal silica that can be formed in and between the vegetal cells (Piperno 1988). The deposition of silica in the cells is under genetic and environmental control. In taxa like the Gramineae (grass family) the so-called silica cells from the epidermis routinely accumulate silica during their life while the long cells accumulate silica when water availability and evapotranspiration are high. In the case of cereals, for instance, irrigation or high water availability during the final stage of the plants life can produce intense silicification of the epidermis and, in some cases, of other tissues (e.g. the mesophyll). When this happens and the organic matter of the plant cells decays, or is burned, phytolith may be released in the sediments as silica skeletons (Miller Rosen 1992). In the silica skeletons the phytoliths retain the original anatomical positions and the cell relationships they had in the plant tissue where they have formed. Opal silica is a rather inert material and phytoliths can survive in sediments for very long time. Indeed, phytoliths have been recovered from very ancient sediments (Strömberg 2002) and from a variety of depositional environments (Madella 1997; Madella *et al.* 2002; e.g. Delhon *et al.* 2003; Sishisa *et al.* 2003). The analysis of phytoliths from archaeological sediments is a useful exercise to understand past agricultural practice and the use of plant materials in the ancient settlement.

Materials and methods

Sampling and extraction

Many samples for phytolith analysis were collected during the 2000 and 2001 field seasons of which, due to time constraints, a sub-sample of 35 from the 2000 season have been analysed for their content in silica skeletons, as a preliminary test of the method in the context of the Körös culture. Extraction of the opal silica was carried out through heavy liquid separation using sodium polytungstate after having eliminated carbonates and organic matter. Clays were separated using Stroke sedimentation. The silica residue was then mounted in liquid and permanent mediums and slides scanned for phytoliths using a Nikon polarised phase contrast optical microscope (magnification x200, x400 and x1000). Only silica skeletons were considered for the present study and a total of 52 rows for each slide were examined to check for their presence.

Counting and identification

Tables 24.1 (Trench 23A), *24.2* (Trench 23B) and *24.3* (Trench 23C) list the silica skeletons recovery in the 35 samples. The observed silica skeletons have been grouped into six categories: cereal chaff, millet chaff, grass culm and leaves, unidentified grass taxa, Dicotyledon taxa and stomata. The identification characters and example photographs for these categories can be seen in *Figs 24.1–2*. The cereal chaff category is formed by the combination of three sub-categories: *Triticum* sp., *Hordeum* sp. and 'not identified chaff' *(Fig. 24.2)*. The identification of wheat type (*Triticum* sp.) and barley type (*Hordeum* sp.) silica skeletons was done on the basis of the characteristics published by Miller Rosen (1992) and Ball *et al.* (1996), and with the aid of a plant epidermis and phytolith reference collection held at the G. Pitt-Rivers laboratory (Department of Archaeology, University of Cambridge). A summary of the diagnostic characters for cereals is given in *Fig. 24.2*, together with example photographs. The identification of cf. *Panicum* sp. was made on the basis of Baenzinger and Zhao (1992) and the reference collection at the GPR lab. The closest match was with *Panicum miliaceum* (common millet).

Several other types of single phytoliths – not represented in the silica skeletons – and starch granules have been observed during the scanning. These categories are not included in the counts tables and they will be the subject of future publications.

Results

Trench 23A

A total of 19 samples were analysed from Trench 23A. The recovery of phytoliths from the samples of this trench is quite unequal and only seven samples produced silica skeletons *(Table 24.1)*. There are samples with high recovery of silica skeletons (e.g. samples D2 134 1491 and C3 129 1333) and samples with no silica skeletons at all (e.g. samples E1 136 1620 and C3 129 1334; see *Table 24.1*). In many cases the samples with no silica skeletons were also completely void of single phytoliths. Considering that the chemistry and preservation environment do not radically change within Trench 23A, the variable recovery of opal silica should be seen as a result of the variability of the material deposited. In fact, the area of the trench is characterised by pits and shallow scoops interpreted as related to several episodes of deposition (see Macphail, chapter 11) and the recovery of phytoliths reflect the heterogeneity and the sort of material deposited. The episodic character of the deposits seems to be revealed also in the mixture of carbonised crop remains, which combines distinct crop by-products from wheat and barley (Bogaard *et al.*, chapter 23). As for the absence of phytoliths from most of the analysed samples, it has also to be considered the possibility that the non-recovery of phytoliths was due to some problems during extraction. However, the void samples were run in different batches and other samples in these same batches did contain phytoliths. This should therefore rule out extraction biases. The question then prompted is why many contexts in Trench 23A are extremely poor in silica skeleton remains. In theory, we should expect the contrary, as in this area there are the most abundant carbonised remains, of which chaff is an important part. This contrasting situation is probably showing the different origin of the refuse in Trench 23A. Indeed, the mixed status of the carbonised remains led to their interpretation, also on the basis of the micromorphology evidence, as 'episodic' depositions (Bogaard *et al.*, chapter 23). Within this episodic deposition we can also consider the phytolith samples that centre on squares C1, D1, C3 and D2 and from context 127 to context 136. The composition of the silica skeleton assemblages is very uniform and cereal chaff is the major component of these samples. The low frequency or absence of phytoliths in most of the other samples from Trench 23A makes clear that chaff and straw, apart

Table 24.1. The occurrence of silica skeletons in Trench 23A

	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
E1 134 1488									
	0	0	6	0	0	0	0	0	6
		6		0	0	0	0	0	6
%		100		0	0	0	0	0	100
D2 134 1491	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	48	6	101	0	63	2	0	0	220
		155		0	63	2	0	0	220
%		70		0	29	1	0	0	100
E1 136 1620	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
C5 129 1335	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	6	0	3	0	0	0	9
		6		0	3	0	0	0	9
%		67		0	33	0	0	0	100
C4 129 1334	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0

Table 24.1. Continued

B5 125 1344									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
B4 125 1345									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
B3 125 1343									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
B2 127 1342									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
B1 127 1341									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0

Table 24.1. Continued

A5 125 1340									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
A4 125 1339									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
A3 125 1338									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
A1 127 1336									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
D1 136 1619									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	10	6	37	0	4	2	0	0	59
		53		0	4	2	0	0	59
%		90		0	7	3	0	0	100

Table 24.1. Continued

E1 134 1488	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0

C1 127 1331	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	18	2	43	2	21	6	0	0	92
		63		2	21	6	0	0	92
%		68		2	23	7	0	0	100

C3 129 1333	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	43	9	112	0	12	3	0	0	179
		164		0	12	3	0	0	179
%		92		0	7	2	0	0	100

D1 134 1490	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	24	0	27	0	0	0	51
		24		0	27	0	0	0	51
%		47		0	53	0	0	0	100

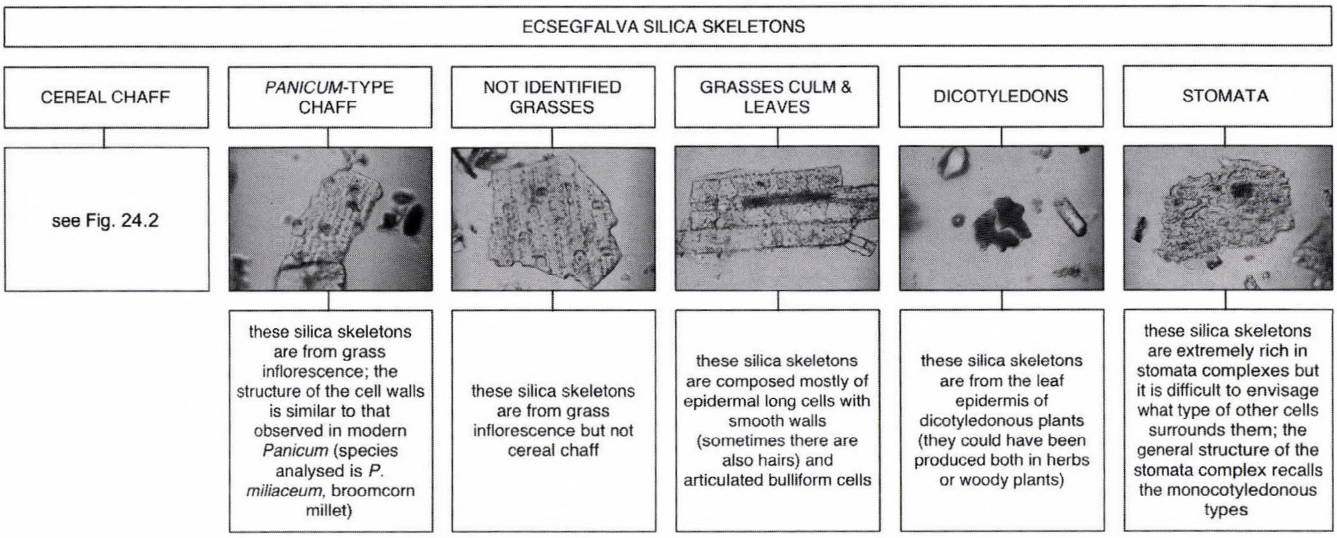

Fig. 24.1. Anatomical characteristics of the silica skeletons from Ecsegfalva

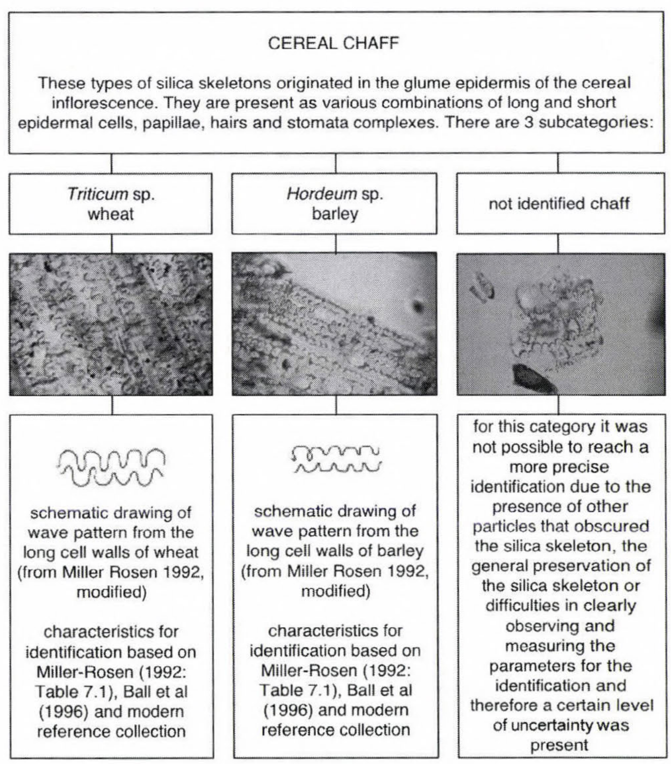

Fig. 24.2. Anatomical characteristics of the cereal chaff silica skeletons from Ecsegfalva

from the discards of carbonised chaff, did not enter the refuse deposits. (It is important here to remember that in these samples we have few silica skeletons *and* few single phytoliths, therefore removing the possibility that the pattern is related to taphonomy.) This, together with the evidence of some sort of processing of the straw (see below), seems to indicate that crop processing by-products played a role in the economy of Ecsegfalva and were not just disposed of but recycled for other purposes. In fact, even barley chaff, which is probably produced away from the habitation areas, is present as phytoliths in most of the samples, and especially in those from the habitation area in Trench 23B (see below), making it evident that barley chaff was carried into the site. Indeed, 'chopped' straw and chaff from the threshing floors are often important commodities for modern agriculturalists (Anderson 2003; and my own personal observations) and they are carefully recovered during threshing and winnowing. These by-products are then stored to be used as vegetal temper or to be mixed with fresh fodder for animal feed or to dung to produce prized fuel. In Pakistan (in the Sindh and Punjab regions), chaff and chopped straw are also used unmixed as fuel for firing pottery (my own personal observations). On the basis of the observations made on the recovery and preservation of carbonised seeds and silica skeletons it is possible to suggest that chaff and straw had an important role in the economy of Ecsegfalva.

For those articulated phytoliths where it was possible to identify the taxon, wheat is more common than barley (see *Table 24.1*). This confirms the carbonised seed analysis (Bogaard *et al.*, chapter 23), where wheat glumes bases represent 26% and wheat grains 14% of the assemblage, with barley grains being only 14%.

Trench 23B

The samples from the main area of excavation, Trench 23B, have much higher composition variability *(Table 24.2)*. Apart from the cereal chaff silica skeletons in Trench 23B, millet-type chaff, several inflorescence epidermal sheets of unidentified grasses, Dicotyledonous epidermal sheets and epidermal sheets with a very high proportion of stomata complexes have been observed. In Trench 23B we observe not only variability in space but also in time. This is probably due to the complexity of the main occupation area and of the plant material input.

An intriguing but not very frequent presence in Trench 23B are the silica skeletons identified as possible common millet chaff (cf. *Panicum* sp.), which they also turn up in very small numbers in one sample in Trench 23A (C1 127 1331). Common millet is a relatively old crop and appears, in settlements of eastern and central Europe, from the late fifth and the fourth millennium cal BC (see Zohary and Hopf 2000). The crop could have been added to the Neolithic Near East crop assemblage soon after this package arrived in central Asia or it could have been domesticated before the arrival of the Fertile Crescent crop assemblage. *Panicum* is, indeed, present as a weedy form in central Asia and it is possible that this area harbours the wild progenitors of *P. miliaceum* (Zohary and Hopf 1994). Unfortunately, there is not much evidence of common millet from Neolithic archaeological sites from this area. An uncertain find of millet comes from the Starčevo-Körös site of Nosa-Biserna Obala (Garašanin 1961; see also *Table 23.5* in Bogaard *et al.,* chapter 23). Remains of common millet have been recovered from Eneolithic sites in Georgia (Lisitsina 1984) and from Tepe Yahya in Iran (Costantini and Costantini-Biasini 1985), not far away from the possible distribution area of the wild progenitors. In Ecsegfalva, one single grain of common millet was recovered from Trench 23C (Bogaard *et al.*, chapter 23). This find does not permit us to consider common millet a cultivated crop and it could have been a weed. The common millet silica skeletons are also in small numbers (see *Tables 24.1–2*), showing that, even if common millet were part of the crop package at Ecsegfalva, it played only a minor role.

Trench 23B: samples from Pit 390/394

Pit 390 is a large feature in the South-East Box and is one of the structures thoroughly investigated by micromorphological analysis (see Macphail, chapter 11). The sample for phytolith analysis (G2 350 6714) comes from the deposits with a more anthropogenic character (chapter 11) and shows some of the highest variability in phytolith composition for Trench 23B, with silica skeletons from cereal chaff, millet-type chaff, grass culm and leaves, wild grasses inflorescence and Dicotyledon plants. These plant materials have originated from the processing waste of domesticated crops but also from wild grasses, hay/straw and leaves of herbs and/or woody plants. It is important here to highlight that the Dicotyledon phytoliths are from the green parts of the plant and not from the wood. Also, their recovery is quite high (9% of the assemblage; see *Table 24.2*). Considering that silicification in dicot plants can be up to 20 times lower than in grasses (Albert and Weiner 2001), the amount of silica skeletons in sample G2 350 6714 (in the middle fill of the pit: see chapter 9 above) implies a concentration of these phytoliths, either in the sediment (e.g. by diagenesis or leaching) or in the input. The micromorphology study highlights that some of the sediments underwent leaching and a likely loss of $CaCO_3$ from the ash-rich deposits of the uppermost layer of the

Table 24.2. The occurrence of silica skeletons in Trench 23B

D8 351 6684									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	2	0	12	0	12	0	0	0	26
		14		0	12	0	0	0	26
%		54		0	46	0	0	0	100
D5 356 8366									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	2	0	14	0	6	2	0	0	24
		16		0	6	2	0	0	24
%		67		0	25	8	0	0	100
G6 342 6702									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	14	2	48	3	88	15	0	0	170
		64		3	88	15	0	0	170
%		38		1	52	9	0	0	100
D3 340 6729									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	2	1	5	0	11	0	0	0	19
		8		0	11	0	0	0	19
%		42		0	58	0	0	0	100
D8 351 8355									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	1	0	9	0	7	0	0	0	17
		10		0	7	0	0	0	17
%		59		0	41	0	0	0	100

Table 24.2. Continued

D9 354 7646									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	6	16	0	11	2	0	6	41
		22		0	11	2	0	6	41
%		53		0	27	5	0	15	100
D10 354/362									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	2	23	5	14	15	0	12	71
		25		5	14	15	0	12	71
%		35		7	20	21	0	17	100
C5 356 8362									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0
%		0		0	0	0	0	0	0
G8 352 8331									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	43	18	25	1	49	10	10	0	156
		86		1	49	10	10	0	156
%		55		2	31	6	6	0	100
G2 350 6714									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	12	11	32	1	33	5	9	0	103
		55		1	33	5	9	0	103
%		53		2	31	5	9	0	100

Table 24.2. Continued

E6 358 8060									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	4	0	15	0	14	0	0	0	33
		19		0	14	0	0	0	33
%		58		0	42	0	0	0	100
C4 340 6726									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	5	2	27	0	16	0	0	2	52
		34		0	16	0	0	2	52
%		65		0	31	0	0	4	100
C11 354 7650									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	2	18	0	5	4	0	0	29
		20		0	5	4	0	0	29
%		69		0	17	14	0	0	100
C11 344 6681									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	1	6	0	15	3	0	0	25
		7		0	15	3	0	0	25
%		28		0	60	12	0	0	100

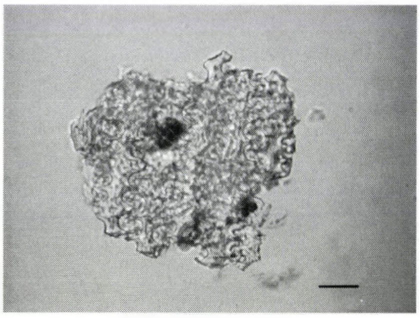

Fig. 24.3. Chaff silica skeleton with rounded edges probably due to ruminant digestion processes; scale = 25 microns

site. However, G2 350 6714 is well below the layers involved (301–335: see also Macphail, chapter 11) in these processes. Therefore, it is possible to interpret this high value of Dicotyledon phytoliths as the result of pre-depositional input. The most likely explanation is that they originate from dung of animals fed on broad-leaf fodder. Part of the non-cereal category might also have originated as animal dung, since hay/straw can sometimes be mixed with broad-leaf fodder. A further indication of the origin for part of the articulated phytoliths from dung is the presence of rounded-off grass silica skeletons where the sheets of phytoliths have rounded edges (see *Fig. 24.3*). This type of wear has been also seen (my own personal observations) in modern samples of cattle dung from Pakistan and it might be the result of the particular type of digestion involved in ruminants. Phytoliths from sample G2 350 6714 therefore support the evidence from the micromorphology analysis for a mixed origin of this deposit and with a plant input related to crop processing and animal herding.

The heterogeneous input of plant material in the pits in this area of the settlement is also emphasised by the silica skeleton assemblage from Pit 394, the northern portion of the same feature as Pit 390 (sample E6 358 8060). In this case the number of observed articulated phytoliths is about a third of that in Pit 390 and their composition is about 60% cereal chaff and 40% grass culm and leaves (see *Table 24.2*). This might indicate a more important input from crop processing by-products. Pit 394 and 390 are both part of the same big pit complex on the east side of Trench 23B (see chapter 9), but they are spatially separate and their fills may belongs to diverse episodes of deposition.

Trench 23B: main occupation deposits

Several samples come from the main occupation deposits of Trench 23B *(Table 24.2).* The input and frequency of plant material for these deposits seem to originate from a complex of activities carried out in the main area of the settlement.

The great similarity in the composition of the sample from the fill of Pit 390 (G2 350 6714) and sample G8 352 8331 from the main occupation layer, and their proximity, may suggest that these two samples belong to the same deposit.

Trench 23C

The low number of samples and the low rate of recovery of silica skeletons from this trench do not allow for a lengthy discussion of the results. However, it is possible to suggest that for sample XY14/15 9351, the only one where phytoliths were recovered, composition of the silica skeleton assemblage is related to cereal crop by-products and probably dung (see *Table 24.3*).

The silica skeletons from Ecsegfalva: an overview

The general recovery of silica skeletons from Ecsegfalva is very good with counts of more than 100 silica skeletons in many samples. The general phytolith input is heavily influenced by cereal crop by-products, in the form of chaff, culm and leaves *(Fig. 24.4).* This seems to indicate that part of the crop processing was carried out on-site (probably the glume wheats) and that chaff and

Table 24.3. The occurrence of silica skeletons in Trench 23C

	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
X14 514 9351									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	2	0	8	0	17	0	2	0	29
		10		0	17	0	2	0	29
%		34		0	59	0	7	0	100
Y15 508 9157									
	Triticum sp	cereal chaff *Hordeum* sp	not id chaff	millet chaff cf. *Panicum* sp	culm/leaf	not id grass	Dicot	Stomata	Total
	0	0	0	0	0	0	0	0	0
		0		0	0	0	0	0	0

straw of all cereal crops were probably re-used for multiple purposes on site (e.g. temper, fodder, fuel). Together with the cereal phytoliths, Ecsegfalva also has a good frequency of non-cereal grasses, Dicotyledon plants and the stomata type. All these categories originate from wild plants that entered the site probably mainly through two major inputs: dung and daub. The dung input has been already discussed above. In respect to input from daub, it is possible to think that the reeds used for structures (see Carneiro and Mateiciucová, chapter 13) would have substantially contributed to the phytolith assemblages. Indeed, single bulliform cell phytoliths with anatomical characteristics of *Phragmites australis/Arundo donax* were frequently observed in the samples (the results of single phytolith analysis will be the subject of a future publication). Reeds typically form vegetation belts around lakes and slow-flowing rivers and can also grow were the soil

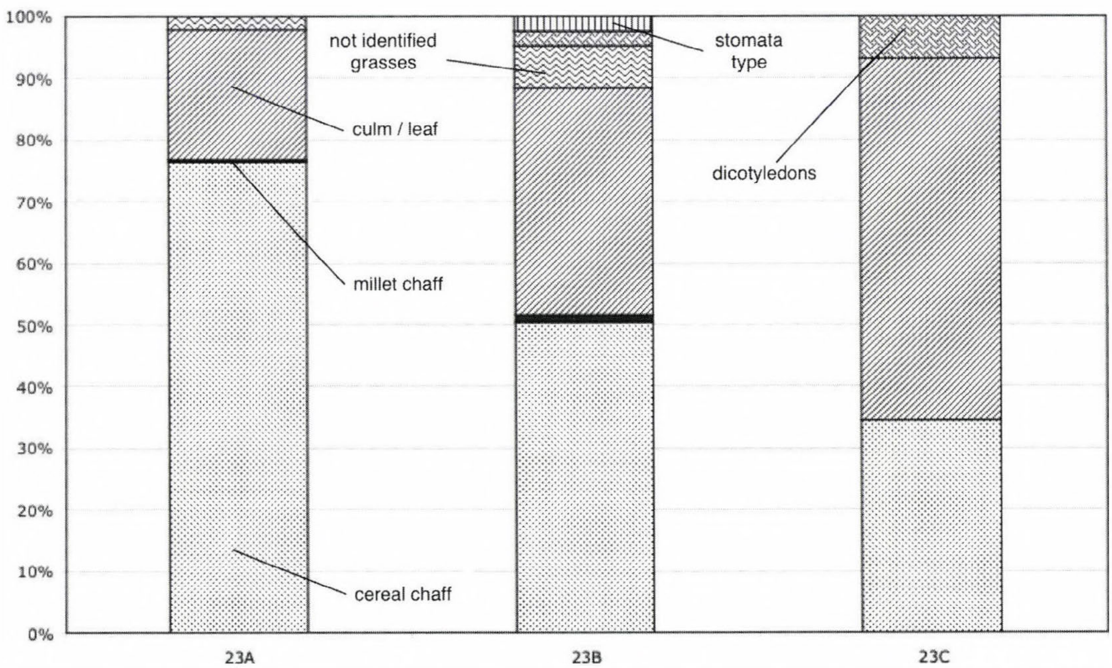

Fig. 24.4. The amalgamated composition of the silica skeletons from Ecsegfalva Trenches 23A, 23B and 23C

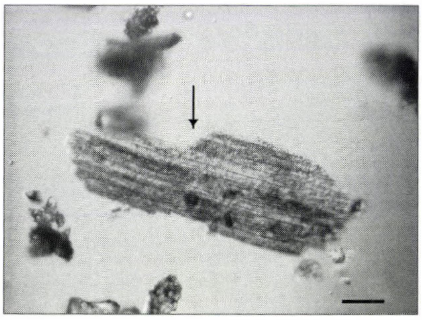

Fig. 24.5. Culm silica skeleton (straw) with cut profile (see arrow) corresponding to incision and scoring due to trampling; scale = 50 microns

moisture is high for most of the year. The phytolith evidence from the Kiri-tó cores also supports the presence of reeds in the surrounding of the settlement (see Windland, chapter 7, and also Willis, chapter 6). Where available, reeds have been typically used in prehistoric Europe, and till recently in many parts of the Mediterranean, to produce wall structures to be then plastered with mud for the creation of the typical wattle-and-daub technique.

Some of the Dicotyledon silica skeletons, as well as of the non-cereal crop categories, might have entered the site because of the exploitation of wild plants from the surrounding environments. However, there is not sufficient information in the dataset at this moment to discuss this hypothesis.

Finally, it is worth noting that many of the observed silica skeletons in Ecsegfalva display very characteristic patterns of breakage. Articulated phytoliths can be imagined as a microscopic jigsaw puzzle, where the single pieces of the puzzle are represented by the different phytoliths neatly fitting together. It is plausible to consider that, after deposition, when the organic matter decays and these sheets break down, they would tend to separate along the lines of minimal strength represented by the junctions of the puzzle pieces. In this way, single phytoliths or small silica skeletons are released in the sediment. However, if breakage or cutting of the plant tissues happens before the organic matter decays, the junctions between cells are not anymore weak points as the cell walls maintain the tissue together. Therefore, breakage can happen between and through the phytolith bodies. This is known to happen during some of the stages of the crop processing technique, for example by the use of a threshing sledge or trampling under animal hooves (Anderson 2003). When a tribulum or sledge is used, plant material rolls against the blades creating distinctive cut profiles. Some of these cut profiles are very regular and characteristic, and they are connected to the particular way the sledge blades score the straw (Anderson 2003). Trampling, on the other hand, produces marks and bends of the straw and the resulting breakage can be simple, straight or curved but always jagged (Anderson 2003). About 30% of the material from Ecsegfalva displays cuts and breakage that can be attributed to the trampling of straw under animal hooves (see *Fig. 24.5*). Considering that about a third of the phytoliths seems to have undergone trampling, it might be suggested that apart from accidental trampling (see Macphail, chapter 11), there was some kind of crop-processing practice. Trampling of the crop with teams of animals was used in prehistoric and historic times for separating the straw from the grains (threshing) and/or for chopping the straw. The use of chopped straw has been recently documented in Syria (Anderson 1999; 2003). The chopped straw and the finer remains from winnowing can be used as fuel (in their own or mixed with dung), fodder or temper for mud in floors and daub. In Ecsegfalva plant-tempered daub has been observed (e.g. samples 10780, 14325, 11884: see Macphail, chapter 11) and the organic matter used for temper might have been a mixture of straw and dung.

Acknowledgements

I would like to express my appreciation: to Liliana Janik who visited Ecsegfalva in 2000 and prepared the phytolith slides at the GPR lab; to Daniela Hofmann who collected all the samples in the field; and to Patricia Anderson for having provided friendly advice and in-depth knowledge on crop-processing phytolith signatures. I would also like to thank Alasdair Whittle for his patience, support and encouragement. Opinions and mistakes are my responsibility alone.

Chapter 25

ANTHROPOLOGICAL ANALYSIS OF THE HUMAN SKELETAL REMAINS

Zsuzsanna Guba, Ildikó Szikossy and *Ildikó Pap*

Human skeletal remains found at Ecsegfalva 23 in 1999–2001 were transported to the Hungarian Natural History Museum in Budapest, where they are deposited in the osteological collection of the Anthropological Department. In accordance with the nomenclature used by the project, they are named as Ecsegfalva 23A (Inventory No. 2005.5.1), Ecsegfalva 23B (Inventory No. 2005.5.2), Ecsegfalva 23C (Inventory No. 2005.5.3). Various anthropological investigations were carried out on them.

Ecsegfalva 23A

In 1999 human skeletal remains were found during the excavation at the Ecsegfalva 23 site in Trench 23A (see Whittle and Zalai-Gaál, chapter 9). They belonged to one adult individual and were dated to the Alföld Linear Pottery culture ('Alföldi vonaldíszes kerámia kultúrája' further AVK) according to radiocarbon dating (see Bronk Ramsey *et al.*, chapter 10) and associated sherds (see Oross, chapter 27). Although much of the human skeleton were represented in the bone remains, the general condition of the bones was rather poor and fragmentary. To avoid further damage no washing was carried out and the bones are stored in more or less their original condition.

Sex and age at death were estimated using standard non-invasive techniques (Ubelaker 1989).

Sex

Its female sex was estimated by the traditional method, which takes the degree of sexualisation manifested on skeleton into account using Acsádi and Nemeskéri's classification (Acsádi and Nemeskéri 1970) and from pelvis morphology, especially the form of the pubis, after Ubelaker (1989). Unfortunately because of the fragmentary and incomplete state of the remains, out of the 22 traits used by Acsádi and Nemeskéri only nine could be detected *(Table 25.1)*, but the hyperfeminine traits on the hip bone make the sex determination fairly certain.

Table 25.1. Traits used for sex determination

Trait	Degree of sexualisation (based on Acsádi and Nemeskéri's classification)
Glabella and superciliary arch	–1
Mastoid processes	–1
External occipital protuberance	0
Body of mandible	–1
Trigonum mentale	–1
Mandibular angle	1
Greater sciatic notch	–2
Linea aspera	+1
Sulcus preauricularis	–2

–2: hyperfeminine, –1: feminine, 0: indifferent, +1: masculine, +2: hypermasculine

Age at death

To determine the age at death various osteological characteristics showing change with ageing can be applied, after Ubelaker (1989). Adult age at death was estimated from the morphology of the pubic symphysis. Other criteria employed included the extent of epiphyseal union, dental attrition, dental loss, morphology of the auricular area of the ilium, vertebral osteophytosis, and other general age indicators of the skeleton.

Abrasion of the teeth is heavy; the symphysial face is worn; and closure of skull sutures is complete.

Taking all the above mentioned into consideration, the individual found at Ecsegfalva 23A site died at an adult age, between 35–44 years of age.

In a previous study Ubelaker, Pap and Graver (unpublished manuscript) analysed a combined sample of 171 Neolithic human remains from north-eastern Hungary and composed a life table. That suggested a life expectancy at birth about 29 years, a life expectancy at age of 15 about 21 years and a maximum longevity of about 60 years for the Neolithic population of this area (Ubelaker, Pap and Graver, unpublished manuscript). Comparisons with later populations from this region were possible because of previous studies of samples from the Copper Age (Ubelaker and Pap, unpublished manuscript), Bronze Age (Ubelaker and Pap 1996) and Iron Age (Ubelaker and Pap 1998). Both life expectancy at birth and at age one decrease slightly from the Neolithic. Life expectancy at birth calculated from the Neolithic sample was 29 years, compared with 28 for the Copper Age, 24 for the Bronze Age and 27 for the Iron Age. Although these differences indicate a temporal change of decreased life expectancy at birth, they are minimal and difficult to interpret because of the possibility of sampling bias. Similarly, the calculation of life expectancy at age one was 28 years based on the Neolithic sample. The value was also about 28 years in the Copper Age and then decreased in subsequent periods to 24 years in the Bronze Age and 27 years in the Iron Age. As with the life expectancy at birth values, these differences are relatively minimal.

Measurable bone dimensions and estimated living stature

Despite the careful excavation, the skull morphology cannot be restored and no dimension can be taken as both the cerebral as the visceral cranial bones are fragmentary and incomplete. The general body build as reflected in the postcranial skeleton was average. The muscular adhesion surfaces show no sign of physical overwork. Because of the incompleteness of epiphyses of the other long bones, only the measurements of the right humerus and ulna could be taken *(Table 25.2)*.

So, the Ecsegfalva 23A individual has only measurable upper limb bones, where the maximum length of humerus shows high correlation (0.9000) with stature (see Sjøvold 1990), while the maximum length of ulna exhibits only moderate (0.7733) (see Sjøvold 1990), if using Sjøvold's formulae for all race both sexes:

$$4.62 \times \mathrm{H1} + 19.00 = 157.6 \pm 4.89,$$
$$4.61 \times \mathrm{U1} + 46.83 = 162.5 \pm 4.97.$$

When averaged this gives an estimated living stature of 160.1 cm.

Table 25.2. Measurements (Martin 1928) taken on the right ulna and right humerus

	Traits	Dimension
U1	Maximum length of ulnae	251 mm
H1	Maximum length of humeri	300 mm
H2	Caput-capitulum length of humeri	297 mm
H5	Maximum diameter at midshaft	18.5 mm

Dental investigation

Oral pathologies were scored by visual inspection. The dental lesions were surveyed with probe, excavator and magnifier. Remaining radices were also recorded and calculated as a tooth. Recognition of caries and premortem loss of teeth was made according to Szikossy and Bernert (2002). Radicular cavities caused by cyst or abscessus as results of dental and alveolar diseases were recorded as well.

The maxillary and mandibular arches are better preserved than the other parts of the face with 25 teeth present. No sign of premortem tooth loss was found, while postmortem five to seven teeth were lost. The optimal teeth numbers were between 30–32. Two of the Wisdom (M_3) teeth were identified, but in the other cases it was impossible to determine the presence of M_3 because of missing part of the maxilla and mandible. Dental caries was observed in 9 cases. We regarded the remaining radices as carious teeth *(Table 25.3)*.

Table 25.3. Incidence of dental caries

Tooth	Caries	Location
M2 left maxilla	Radix present only	–
M3 left maxilla	Caries penetrans	Interproximal surface
P2 left mandible	Caries media et profunda	Interproximal surface
M1 left mandible	Caries media et profunda	Interproximal surface
M3 left mandible	Radix present only	–
M1 right maxilla	Caries penetrans	Interproximal surface
C right mandible	Radix present only	–
P1 right mandible	Radix present only	–

The incidence of cyst or abscessus was pretty frequent, and three cases were observed. Both were small size and they were around molar teeth.

The dentition shows heavy abrasion that is more dominant on the frontal teeth and even on the maxillary and mandibular dental parts. The dentition of this individual exhibited grooves on the occlusal surface of two maxillary incisors, which are probable caused by a non-dietary activity. A detailed description and a comparative analysis of this phenomenon can be found in chapter 26.

Palaeopathological investigation and stress indicators

The remains were checked for any sign of evidence suggesting trauma, anaemia and infection, dental disease and other gross pathology. No severe pathological alteration was found, that corresponds to the fact that this woman lived a fairly long life and – as mirrored in her bones and teeth – in relatively good health. Neither severe anomaly at a young age (Harris line, dental hypoplasia, cribra orbitalia) nor a decrease in her health state with ageing (porotic hyperostosis, vertebral osteophytosis) nor a serious infection or trauma is reflected in her skeleton *(Table 25.4)*.

Table 25.4. Stress indicators investigated

Dental hypoplasia	none
Dental caries	9
Alveolar cyst or abscesses	3
Premortem tooth loss	none
Cribra orbitalia	none
Porotic hyperostosis	none
Vertebral osteophytosis	none
Trauma	none
Abnormal periosteal lesions	none
Harris line	none

The dental health of the Ecsegfalva 23A individual was relatively poor. The occurrence of caries was less common in the Neolithic than today; out of 735 permanent teeth analysed in Hungarian Neolithic samples (Ubelaker, Pap and Graver, unpublished manuscript), 46 were carious (6.3%).

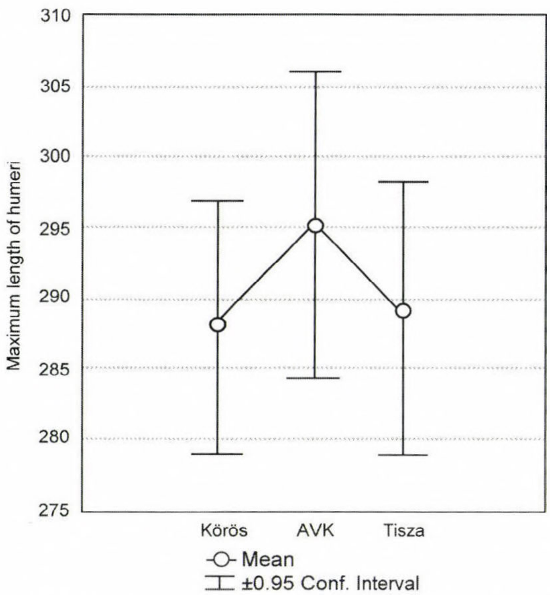

Fig. 25.1. Mean humerus length in three Neolithic female samples. (KS – Early Neolithic Körös-Starčevo culture, N = 14; AVK – the Middle Neolithic Alföld Linear Pottery culture, N = 9; Tisza – Late Neolithic Tisza-Herpály-Csőszhalom culture, N = 11)

Table 25.5. ANOVA table for the humerus length in three Neolithic female samples

Source of variation	SS	df	MS	F	p
Among groups	360	2	180	0.79	0.465
Within groups	7097	31	229		
Total	7456	33			

Long bone dimensions show strong sexual dimorphism, so males and females are to be analysed separately. Comparative analysis on female long bone measurements was carried out using the database composed by Éry (1998) and unpublished data which contain long bone lengths for 14 individuals from the Early Neolithic Körös-Starčevo culture, nine individuals from the Middle Neolithic AVK, and 11 from the Late Neolithic Tisza-Herpály-Csőszhalom culture. These are the available female long bone lengths at present to represent the population of Neolithic in the Great Plain and its northern fringes. Éry (1998) found that the populations of this territory tend to differ from the Transdanubian ones in their postcranial traits as well, similarly to other recurrent east-west distinctions in the archaeology of the Carpathian Basin.

Fig. 25.1 shows the changes of mean length of humerus in the three Neolithic cultures in our sample. The overlapping feature indicates that the populations are not distinct in this trait, and that was confirmed by the one way variance analysis of the humerus length *(Table 25.5)*; the intra-group variance highly exceeds the inter-group variance.

Is that only true for the humerus or for all the long bones? That question had arisen and to answer it we went back to the database composed by Éry (1998). To investigate the maximum covariance of four long bone measurements (maximum length of humerus, femur, tibia, radius) among groups we carried out a discriminant analysis on the 33 individuals' data. As most of the data available were incomplete, i.e. not all of the four measurements could be taken for one individual, the missing data were replaced with the group means. *Fig. 25.2* shows the two-dimensional scattergram of the two canonical variates (Root1, Root2). Although in a discriminant analysis the canonical variates are composed in such a way that they explain the aggregation of groups maximally, in our case they do not really form groups according to the three cultural classes we applied (Körös-Starčevo culture, AVK, Tisza-Herpály-Csőszhalom culture). The distribution of the Körös-Starčevo and Tisza complex is absolutely overlapping, while some of the AVK individuals tend to take a slightly distinct position in Root1. The Ecsegfalva 23A individual is labelled; it has got a rather central position. However, these results suggest that no statistically significant distinction among these Neolithic cultures can be expected when analysing their long bone length and also their derivatives such as for example stature.

The robusticity of the long bones can also be compared if we have their diameters. Unfortunately, published data of this kind are scarce. For the humerus, apart from the Ecsegfalva 23A individual we checked six other individuals' humerus diameter (Early and Middle Neolithic) and

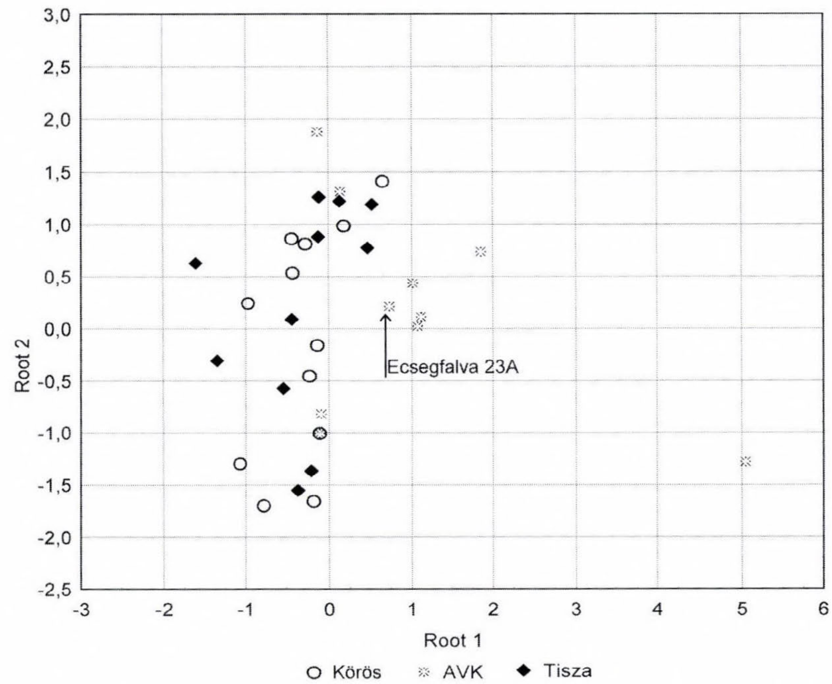

Fig. 25.2. Individual scattergram of the canonical discriminant variates derived from long bone measurements in the composed Neolithic sample. (KS – Early Neolithic Körös-Starčevo culture, AVK – the Middle Neolithic Alföld Linear Pottery culture, Tisza – Late Neolithic Tisza-Herpály-Csőszhalom culture)

displayed their relationship in a scattergram *(Fig. 25.3)*. There are too few data to draw conclusions, but Ecsegfalva 23A takes an outlying position, being the longest but slim.

Stature is a classic example of polygenic inherited trait, which is also substantially influenced by environmental factors during foetal life, childhood and adolescence (Sinclair 1989). So it is true for the long bone measurements, which are the main determinants of body height. In modern societies, about 20% of variation in body height is due to environmental variation (Silventoinen 2003). In poorer environments, and that must be true for the Neolithic way of life, that figure is probably larger. Analysis of recent humans that differ in terms of lifestyle and climatic adaptations reveals that limb bone robusticity varies with climate as much as or more than with lifestyle (Pearson 2000). Interestingly, women's body height seems to be more susceptible to environmental factors (Silventoinen *et al.* 2003). Since stature is very ecosensitive during ontogeny it is very difficult to assert of past populations that a short stature is a genetic adaptation or just a sign of a faltering growth due to chronic malnutrition. So it is conversely equally true that no significant inter-population change in postcranial traits does not exclude genetic and/or environmental changes. Bearing that in mind, we must be cautious when interpreting the results. Also, whereas no statistically significant distinction among the groups investigated by us can be shown, any 'trend' observed might well be due to insufficient sampling.

In an earlier summary, Menk and Nemeskéri (1989) have found that changes from the Mesolithic to the Middle Neolithic populations involve a progressive decrease in stature, in robustness and also in the dimensions of the entire faciocranial complex. Others say, while stature declined significantly between the Early Upper Palaeolithic and the Neolithic, as part of a general gracilisation trend, body proportions are more conservative (Froment 2002). Piontek and Vančata (2002) also observed some microevolutionary changes in stature and body proportions in the Upper Paleolithic/Neolithic transition. They found that a Linear Pottery culture sample (from Germany) could be characterised with by short bones, robust males and more gracile females,

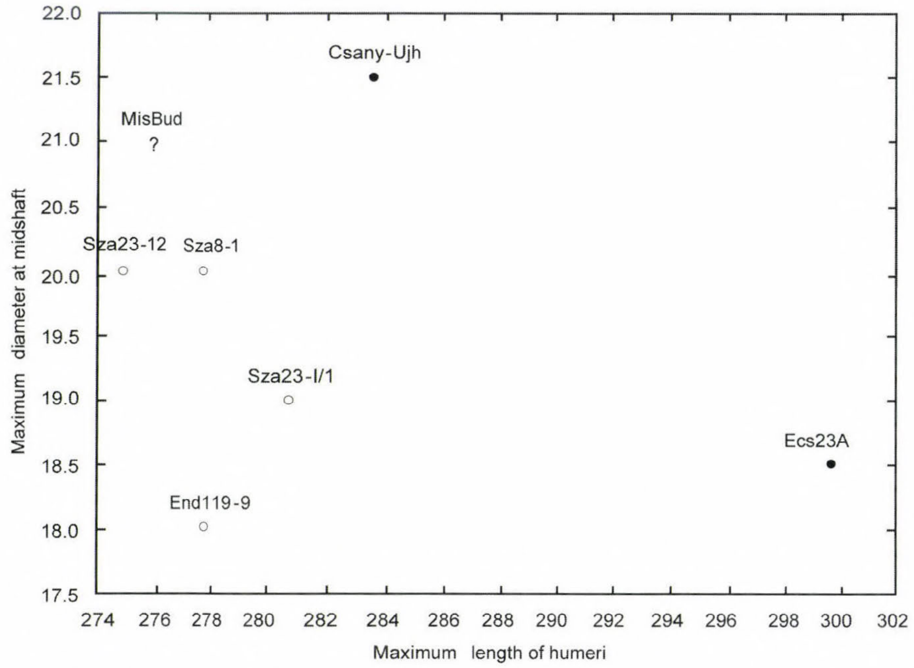

Fig. 25.3. Length and diameter of humeri in 7 Neolithic remains examined. ○ Körös culture, • AVK. (MisBud: Miskolc-Büdöspest; Csany-Ujh: Csanytelek-Újhalastó; Ecs23A: Ecsegfalva 23A; Sza23–12: Szarvas 23, grave 12; Sza23–I/1: Szarvas 23, grave I/1; End119–9: Endrőd 119, grave 9)

while Mesolithic and a Corded Ware culture sample (from Germany and Poland) had medium-length bones and medium robusticity in both sexes. Our data do not refer to a gracilisation with time on this scale either. The mean humerus length is the shortest in the Körös-Starčevo group and highest in the subsequent AVK *(Fig. 25.1)*, and for the robusticity of humerus the younger ones are more gracile *(Fig. 25.3)*. That is concordant with the theory that AVK evolved through the long coexistence of early agriculturists and hunter-gatherers. When the spread of Neolithic way of life stopped at the Central European-Balcanic agroecological barrier (Kertész and Sümegi 1999) in the Early Neolithic, the coexisting Mesolithic people might have taken up agriculture by cultural diffusion, and the increased robusticity of the Linear Pottery group that we found could be the trace of their robust Mesolithic forebears. We have to note that this explanation requires knowledge of the anthropology of Mesolithic inhabitants of the Carpathian Basin. At present we do not know any human remains from the Mesolithic Carpathian Basin, but as more and more archaeological excavation proves that the Carpathian Basin was inhabited in the Mesolithic (Kertész 2002), human remains from this period can be expected to turn up sooner or later.

Ecsegfalva 23B

Two fragments of an infant's skeleton and two deciduous teeth were excavated at Ecsegfalva 23B site. They are dated to the Körös culture (see chapter 9). The bone remains are a diaphysis fragment of tibia and a proximal epiphysis fragment of right ulna. No ossification occurred between epiphysis and diaphysis of either long bone, which means that the infant must have been younger than 12 years (Johnson 1961). The mandibulary teeth DM_1, DI_1 are completely developed, so they belonged to a child who died after its 3.5 years of age (Schour and Massler 1940). We can estimate the maximum length of tibia at c. 167 mm or more, which suggests an infant at 6–7 years of age (Ubelaker 1989).

The child's sex can not be determined from bone/teeth morphology.

While the teeth are healthy with no sign of dental hypoplasia, when we X-rayed the tibia, Harris lines were detected. Lines of arrested growth or the so-called Harris lines, reflect horizontally oriented bands of relatively dense bone located in the long bone diaphysis. They represent areas of increased density left behind by an interruption of longitudinal growth. These lines offer some evidence of morbidity, although they cannot always be correlated with disease or nutritional problems and they are vulnerable to remodelling. Radiographs were prepared by placing the tibia in an anterior posterior position on the radiographic plate. The developed radiographs were then observed for the presence of lines (see *Fig. 25.4*), where a complete line could be observed, and also some incomplete lines. The percentage of individuals affected by lines of arrested growth was 12.5% in the succeding Copper Age in Hungary (Ubelaker and Pap 1998).

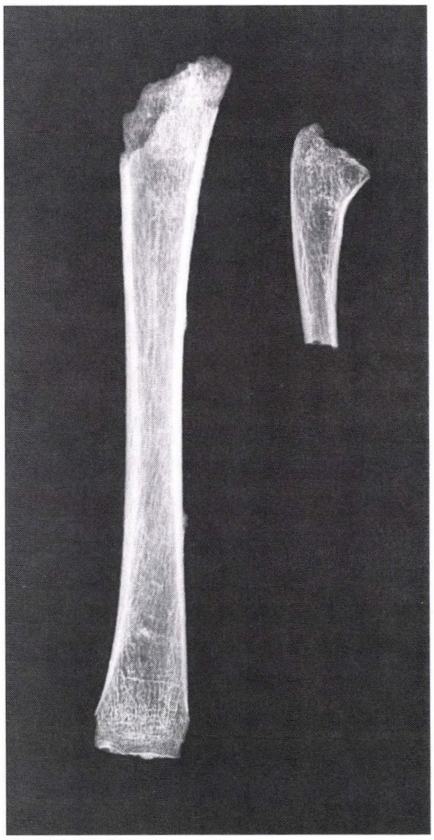

Fig. 25.4. Radiograph of the 23B individual's tibia showing a complete Harris line

Ecsegfalva 23C

The human remains that were found at Ecsegfalva 23C include skeletal remains and teeth of an infant and an adult's tooth (see chapter 9). The infant is radiocarbon dated to the first millennium AD (see chapter 10).

The child's remains include fragments of skullcap, eight deciduous and 16 unerupted permanent teeth. None of them show any pathological alteration. Age at death based on the formation of crowns and roots (Schour and Massler 1940) is 4–5 years.

No sex determination is possible from the morphology of the remains.

Acknowledgement

The authors gratefully acknowledge Lilla Alida Kristóf for her assistance in taking the X-Ray photos and the Institute of Radiology, Semmelweis University College of Health Care.

Chapter 26

THE EVIDENCE OF TEETH

Rick Schulting, Antónia Marcsik and *Ildikó Pap*

Non-dietary occlusal grooves on anterior maxillary dentition in the Hungarian Neolithic

Rick Schulting

Introduction

The single complete human burial found during the Ecsegfalva 23 excavations was of an adult female (see Guba *et al.*, chapter 25). The dentition of this individual exhibited grooves running in a transverse direction on the occlusal surface of two maxillary incisors. This brief report discusses this finding and other individuals from the Hungarian Neolithic exhibiting teeth with occlusal grooves. The findings are put into a wider context through the consideration of similar grooves in two Early Neolithic sites in Slovakia and the Czech Republic. The grooves are attributed to a repetitive activity unrelated to use of the teeth in mastication. Scanning electron microscopy is used to provide further detail on their formation, and likely activities responsible for their formation are discussed.

Non-dietary dental grooves are known from prehistoric sites in many parts of the world. They appear to be best documented in North America (particularly the Great Basin, California, the Northwest Coast, and the Arctic) and in Australia (Pedersen 1952; Cybulski 1974; Schulz 1977; Larsen 1985; 1997; Pedersen and Jakobsen 1989; Brown and Molnar 1990; Milner and Larsen 1991). Examples are also known from the Neolithic of the Near East (Molleson 1994). Microwear analysis and ethnographic data indicate that the grooves are most likely the result of repeatedly pulling plant fibres or animal sinew across the teeth during the manufacture of basketry, thread and cordage.

Non-dietary dental grooves tend to be strongly associated with one sex or the other, indicating that the tasks involved in their formation are frequently gendered activities. In the Great Basin, non-dietary grooving is associated with males (Larsen 1985; 1997; Milner and Larsen 1991), while on the Northwest Coast and in the Arctic grooving is strongly associated with females (Pedersen 1952; Cybulski 1974; Pedersen and Jakobsen 1989; Hart Hansen *et al.* 1991). In the case of the Arctic, ethnographic evidence documents the women's use of teeth in the manufacture of sinew thread. For the Northwest Coast, ethnographic evidence demonstrates that basketry and weaving were tasks done by women. One strand of root fibre was held in the mouth when making baskets. In California, however, anterior occlusal and interproximal grooves are found on the teeth of both male and female skeletons (Schulz 1977). Posterior interproximal grooves were found on both males and females in one sample from South Australia, although they were twice as common on males (Brown and Molnar 1990). While anterior occlusal and interproximal grooves are now widely accepted as being the result of working plant or animal materials (Milner and Larsen 1991), posterior interproximal grooves are often known as toothpick grooves and are thought to relate to oral hygiene (Willey and Hofman 1994). However, Brown and Molnar (1990) argue that, as with occlusal grooves, they can also result from working plant fibres or animal sinew. This interpretation has been questioned by Frayer (1991) who points out the impracticality of creating a groove through the working of thread between adjacent teeth this low down on the tooth (just above the gumline) and this far back in the mouth (they occur on premolars and molars). Similar considerations might be thought to apply to the creation of a groove in this location with a 'toothpick'. In any case, the debate need not be pursued here, as no interproximal grooves have been noted on the material under consideration.

A final important point to be made is that in the majority of the above cases, only a subset of the population shows dental grooving. This suggests that the tasks involved were to some extent specialised.

Dental grooves in Neolithic Hungary

In order to place the occlusal dental grooves noted on the Ecsegfalva 23 individual into a broader context, a wider examination was made of Earlier Neolithic (Körös and AVK) and later Neolithic dentition in Hungary. Material was examined from the Departments of Anthropology at the Hungarian Natural History Museum, Budapest and at the University of Szeged. At the time it was thought that the Ecsegfalva skeleton was of Körös date (it has subsequently been dated to the AVK period: see chapters 9, 10 and 25), so that this was the main focus of the investigation, with all individuals attributed to this period being examined. A total of 126 anterior teeth from 23 individuals were examined from the Earlier Neolithic (occlusal non-dietary grooves only occur on the anterior dentition). Few individuals had the complete complement of anterior teeth due to both antemortem and postmortem loss, and indeed six individuals were represented by only one or two teeth. A total of 172 anterior teeth from 24 individuals were examined from the later Neolithic. Three additional examples of non-dietary occlusal grooving were found during this study,

Table 26.1. Hungarian Neolithic individuals exhibiting non-dietary occlusal grooving

Site	Burial no.	Date	Age	Sex	Tooth (all maxillary)	Width (mm)	Depth (mm)	Comment
Ecsegfalva 23A	B1	AVK	adultus	F	R central incisor	1.2	0.3–0.4	
Ecsegfalva 23A	B1	AVK	adultus	F	R lateral incisor	1.0	0.2–0.3	
Tiszavasvári-Deákhalmi dűlő	11	AVK	maturus	F	R lateral incisor	2.1–2.7	1.2	discontinuous
Tiszavasvári-Deákhalmi dűlő	11	AVK	maturus	F	R central incisor	1.3	0.2–0.3	
Tiszavasvári-Deákhalmi dűlő	11	AVK	maturus	F	R central incisor	1.0	0.2–0.3	lingual, in line w+ groove on RLI
Tiszavasvári-Deákhalmi dűlő	11	AVK	maturus	F	L central incisor	2.5	1.3	labial
Kisköre-Gát	68.29.29	LN	maturus	M?	R lateral incisor	1.2	0.5–0.9	
Aszód-Papiföldek	68.23.18	LN	adultus	I	R lateral incisor	not available	two grooves run into one	possible groove
					average =	1.5	0.6	

from the sites of Tiszavasvári-Deákhalmi dűlő (Grave 11, dating to the AVK period), Kisköre-Gát (68.29.29) and Aszód-Papiföldek (68.23.18) (the latter two sites both dating to the Hungarian Late Neolithic) *(Table 26.1)*. All the examples are on the maxillary dentition; no cases of non-dietary grooving were noted on the mandibular dentition.

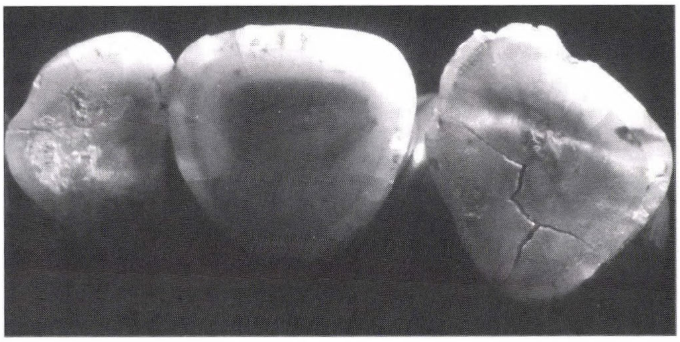

Fig. 26.1. Maxillary dentition of the adult female from Ecsegfalva 23A, showing occlusal grooves on the right central and lateral incisors

The dentition of the Ecsegfalva 23 individual revealed clear non-dietary grooving on the occlusal surface of two maxillary incisors, running in a transverse, medio-lateral direction *(Fig. 26.1)*. The teeth affected are the right central and the right lateral incisors. The groove is more pronounced on the right central incisor, while the groove on the right lateral incisor is discontinuous across the tooth, although the two segments are in alignment. Rather than presenting a flat surface, the central part of the occlusal surface of this tooth is slightly concave, and so only the edges of the tooth display the grooves. The grooves on the two teeth align reasonably well, suggesting a single direction of movement across the affected teeth. Both grooves are about 1 mm in width and from 0.2 to 0.4 mm in depth.

The skeleton of Grave 11 from Tiszavasvári-Deákhalmi dűlő, also an adult female, shows four clear grooves affecting both central maxillary incisors and the right maxillary lateral incisor. Three different orientations are indicated, two of which involve only one tooth, and the third of which involves two teeth (the right lateral and right central incisors). The right central incisor exhibits two shallow grooves *(Fig. 26.2)*. In all cases the general orientation of the grooves is medio-lateral. Width and depth varies on the different teeth affected *(Table 26.1)*, with the grooves on the right lateral incisor and the left central incisor being the deepest of any noted (1.2–1.3 mm). These are not in alignment, and indicate quite different directions of movement.

Both of the later Neolithic individuals exhibiting occlusal grooving are also adult; the Kisköre-Gát individual is probably male, while sex is uncertain for the Aszód-Papiföldek individual. In both cases the right lateral incisor is the affected tooth. The Kisköre-Gát specimen exhibits two shallow but distinct grooves, one behind the other, and in slightly different orientations *(Fig. 26.3)*. The Aszód-Papiföldek example should be seen as tentative only, as the groove is slight and has not been examined under SEM.

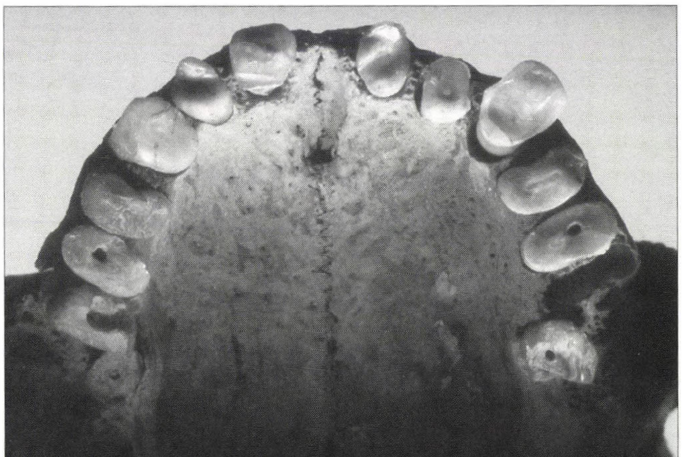

Fig. 26.2. Maxillary dentition of the adult female from Tiszavasvári-Deákhalmi dűlő (Grave 11), showing occlusal grooves on the both central incisors and the right lateral incisor. The right central incisor exhibits two grooves

The overall average dimensions for all teeth exihibiting clear grooves are 1.5 mm in width and 0.6 mm in depth. The sample size is small, but on the available examples there seems to be a preference for working on the right side of the mouth *(Table 26.1)*.

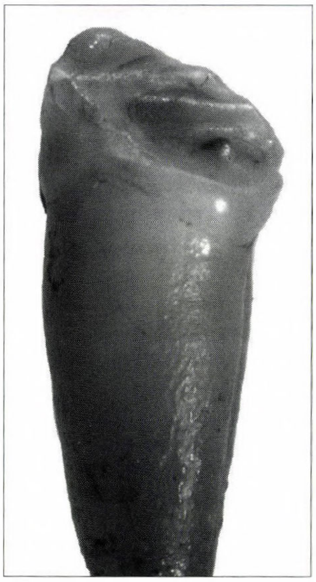

Fig. 26.3. Lateral view of the maxillary right lateral incisor from an adult male from Kisköre-Gát (68.29.29)

Regarding the prevalence of non-dietary grooving, a total of 126 anterior teeth from 23 individuals belonging to the Earlier Neolithic were examined, but four of these had only a single anterior tooth. As an approximation, then, it can be stated that two out of some 20 Earlier Neolithic adult individuals show non-dietary grooving (10%). If the possible case of Aszód-Papiföldek is accepted, then a comparable incidence applies to the 172 anterior teeth from 24 Late Neolithic individuals examined (all of which had at least three anterior teeth). It is likely that this somewhat under-represents the actual incidence of grooving, as few individuals had complete anterior dentitions.

Comparative European Neolithic data

The closest point of comparison with the Hungarian material comes from recent work on the large LBK cemeteries of Krškany (Slovakia) and Vedrovice (Czech Republic), where Frayer and Minozzi (2003) identified evidence of manipulative anterior tooth wear on 24 of 89 individuals examined (27%). These were termed 'notches' by Frayer and Minozzi, reflecting their predominant location on the corners of teeth rather than on the occlusal surface. Of the 24 individuals, 21 were identified as female, two as male, and one as indeterminate (a child). The two males involved in the activity show shallower grooves, indicating less prolonged activity (Frayer and Minozzi 2003, 205). The grooves are deeper in older individuals, but are also found on very young individuals, with the earliest appearance on a child of approximately age nine. One side is always favoured over the other, although the distribution between right and left is approximately equal overall. One elderly female from Krškany (Frayer and Minozzi 2003, fig. 3) shows occlusal grooving more comparable to that seen in the Hungarian individuals. The estimated size of the material being worked through the grooves is between 0.6 mm and 3.5 mm maximum (those at the large end of the range result from the convergence of two smaller grooves).

No extensive literature search has been made for other examples of non-dietary grooving dating to the LBK period in central Europe. That there is some antiquity to the practice in Eurasia is demonstrated by the presence of classic occlusal grooving affecting the entire anterior mandibular tooth row at the Early Neolithic site of Abu Hureya in Syria (Molleson 1994).

SEM analysis

To provide further detail on their formation, high-resolution dental moulds of the grooves were taken (using Coltène President Light Body) and positive epoxy resin casts made (using Araldite MY 853 epoxy resin and hardener XD 716). The casts were gold sputter-coated and examined under scanning electron microscope (SEM). Two SEMs were employed, a Camscan Maxim 2040 (Cardiff University) and a Jeol 6400 (Queen's University Belfast). Examination of the grooves was made at varying magnifications.

An image of the right central incisor from Ecsegfalva confirms the presence of multiple parallel striations that are the result of working some material through the groove *(Fig. 26.4).* These parallel striations are diagnostic of activity-related wear, and easily distinguish the grooves from any masticatory process and from post-depositional erosion.

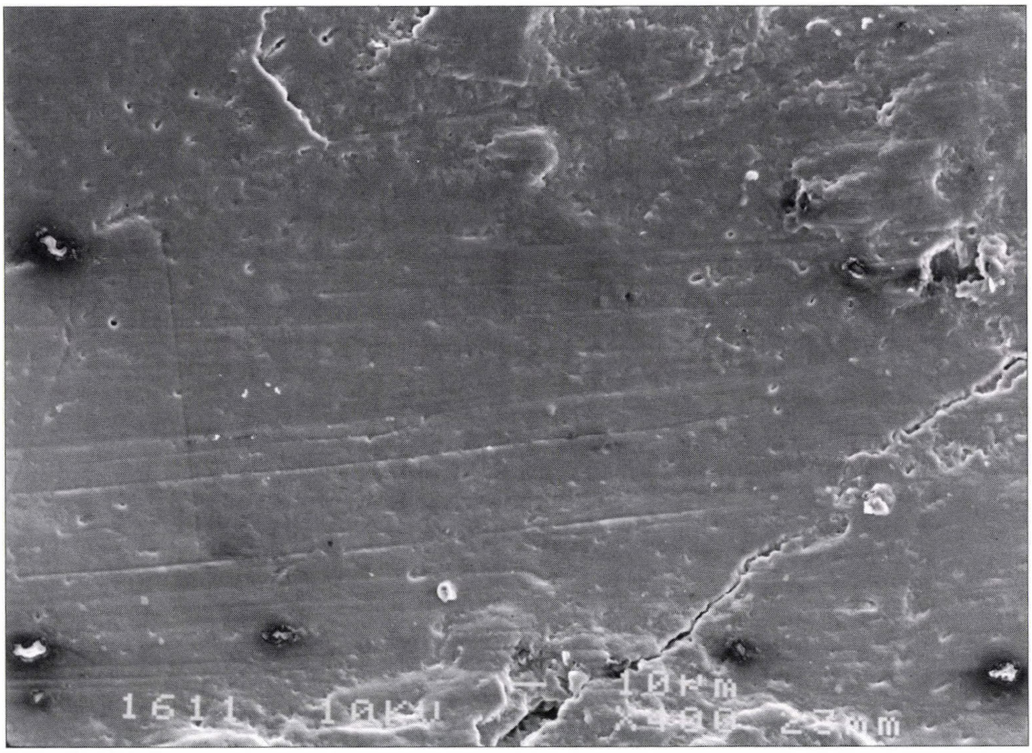

Fig. 26.4. SEM image (c. 400x) of the groove on the right central incisor of Ecsegfalva 23A (2005.5.1)

SEM images of the right central incisor from Tiszavasvári-Deákhalmi dűlő Grave 11 again show multiple parallel striations, although in this case they are partly overlain by striations in more random orientations *(Figs 26.5–6).* These are the kinds of features that result from normal use in food mastication (Teaford 1991); such features can form very rapidly, changing on an almost daily basis (Teaford and Lytle 1996). The groove on the right lateral incisor of the Kisköre-Gát individual also shows clear parallel striations *(Figs 26.7–8).*

Hanging by a thread: materials used

It is widely accepted that occlusal grooves are the result of repeated activity involving the pulling of some thread-like material across the teeth. Ethnographic accounts indicate that the anterior dentition was often employed during the preparation of plant fibres or animal leather or sinew for the manufacture of thread or basketry. A number of different plant fibres would be suitable for making thread, including flax, hemp and nettle. Archaeologically, flax (*Linum usitatissimum*) is not found in Hungary until relatively late. The Early Bronze Age Nagyrév culture site of Dunaföldvár-Kálvária provides the earliest flax find in Hungary, while the second earliest examples comes from the tell site of Tiszaalpár-Várdomb (Gyulai 1993). However, flax is known to be present from the Neolithic onwards in central and west Europe, and so it is likely to have been present in Hungary at this time (Gyulai 1993; see also Makkay 2001). Nettle would have been present naturally, while hemp was possibly introduced sometime in the Neolithic and so may also have been available (Sherratt 1991). Bast fibres from other plants could also have been used to make thread.

The use of both leather and sinew for various purposes is highly probable, although of these two animal products leather would be an unlikely candidate for working in strips as thin as

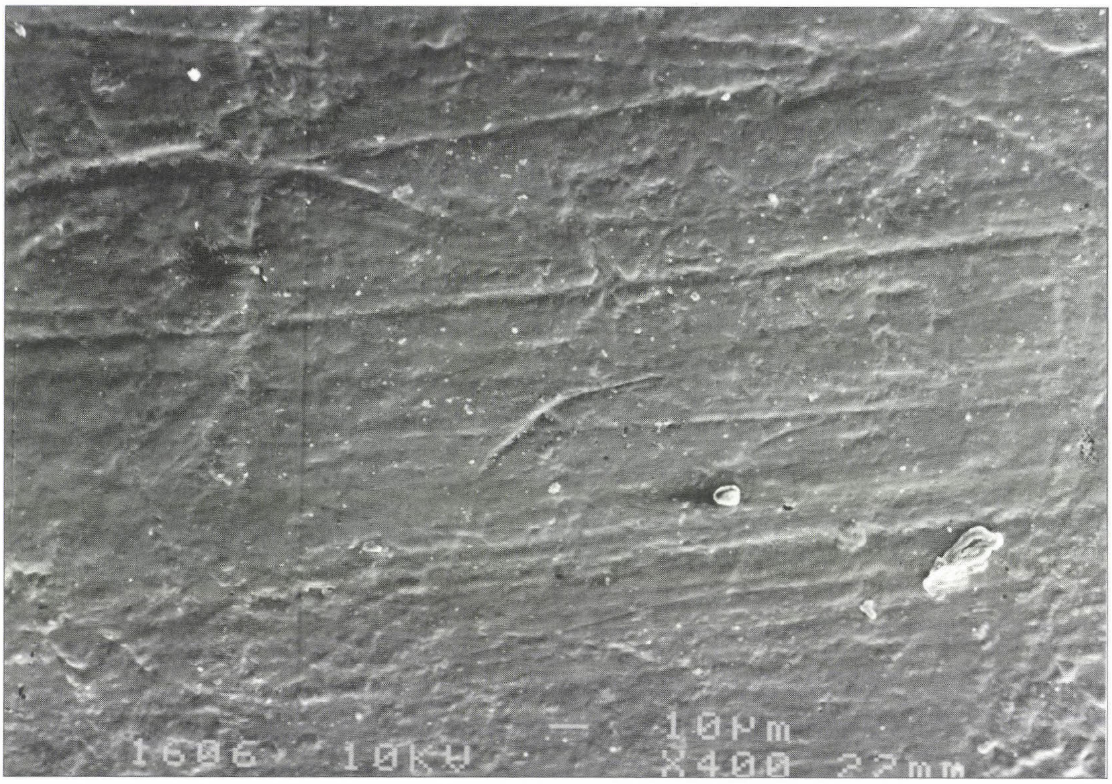

Fig. 26.5. SEM image (c. 400x) of the groove on the right central incisor of Tiszavasvári-Deákhalmi dűlő (11)

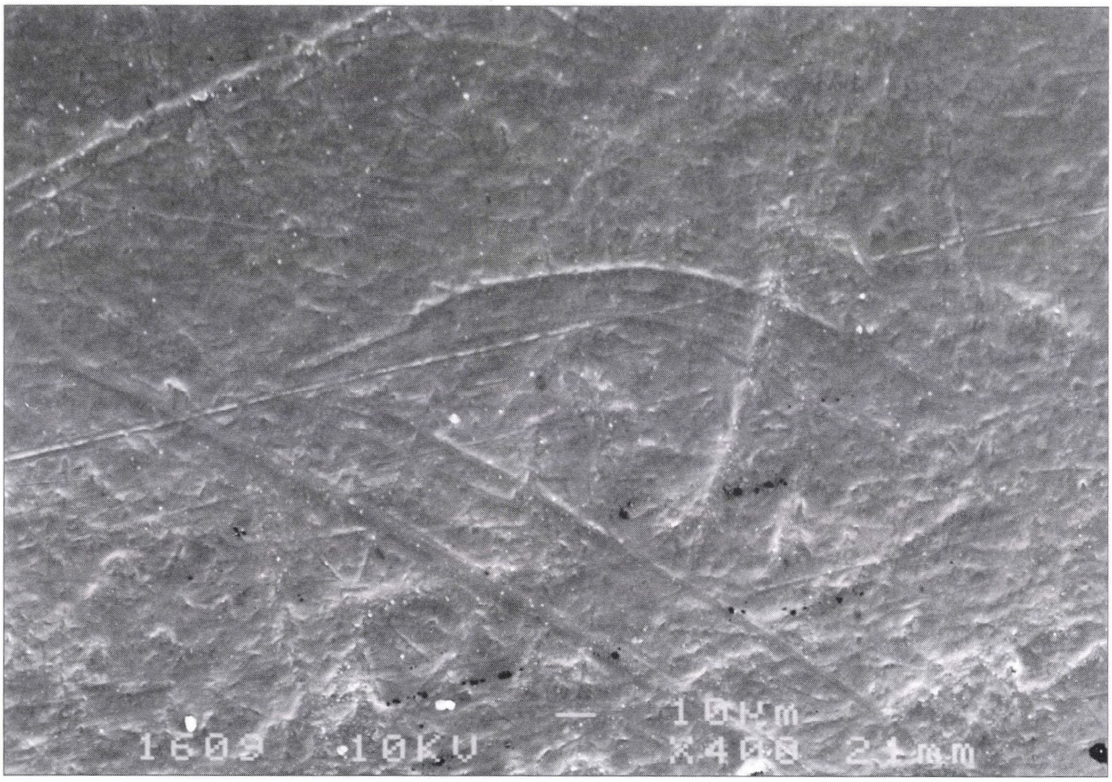

Fig. 26.6. SEM image (c. 400x) of the groove on the right lateral incisor of Tiszavasvári-Deákhalmi dűlő (11)

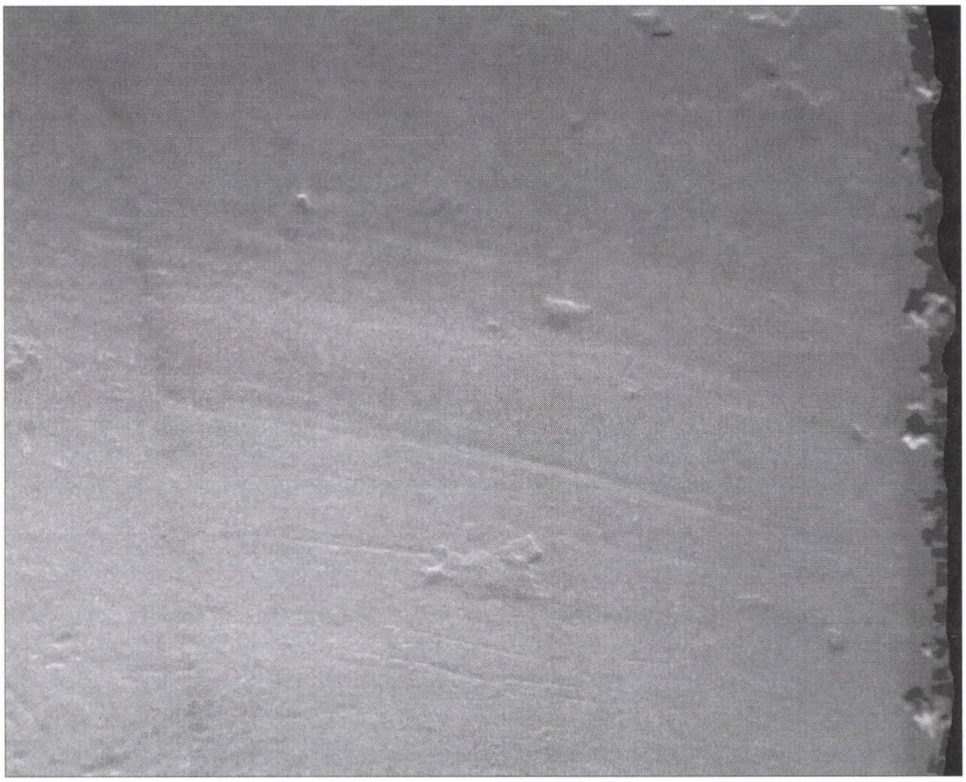

Fig. 26.7. SEM image (c. 265x) of the groove on the right lateral incisor of Kisköre-Gát (68.29.29)

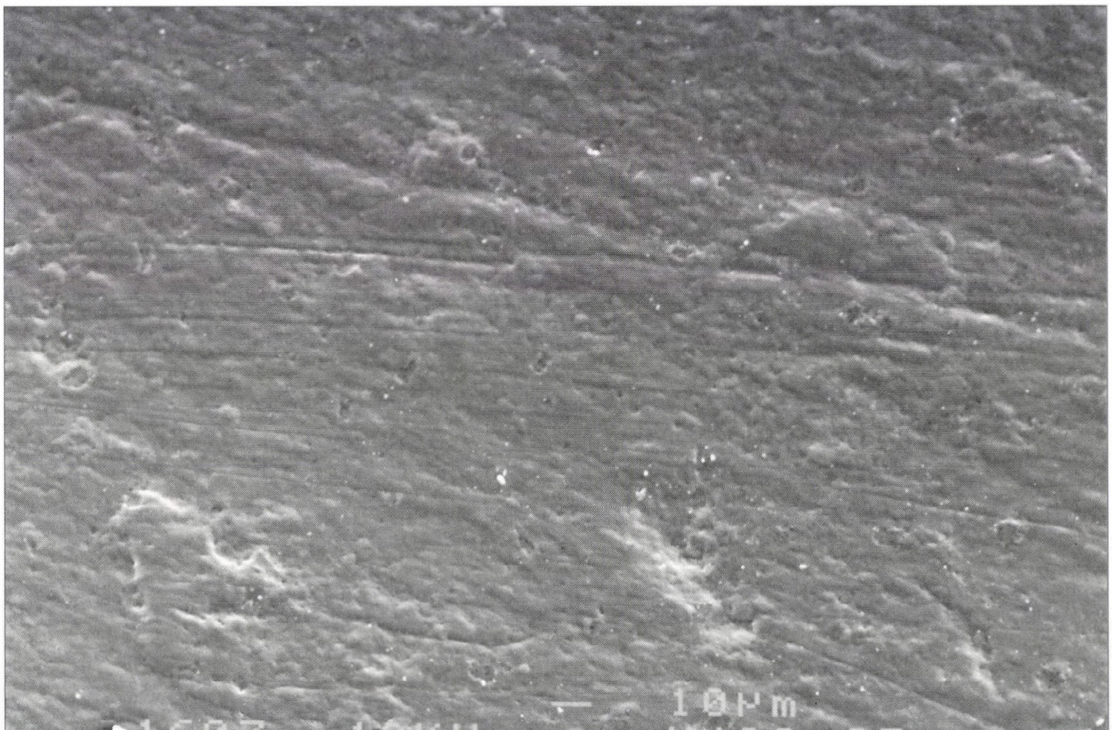

Fig. 26.8. SEM image (c. 400x) of the groove on the right lateral incisor of Kisköre-Gát (68.29.29)

1–2 mm, as it would lack strength. In terms of sinew, the kinds of animals readily available would greatly influence what could be done. Cattle and sheep are the most common animals represented on Neolithic sites in Hungary; while sheep often dominate numerically, cattle dominate in terms of meat-weight (Bartosiewicz, chapter 14; Bökönyi 1992a; Vörös 1994). However, although usable, the sinews of neither animal are very well suited to the making of thread. Far more suitable are cervids, but deer are very rare on Hungarian Neolithic sites, and hunting does not appear to have been an important element of the economy (Bartosiewicz, chapter 14). Ideally, experimental work should be undertaken to assess the qualities of sinew from the various animal species represented.

Certainly the bone tool industry from Ecsegfalva 23 and other Körös and AVK sites suggests a concern with thread and textile manufacture and use (Choyke, chapter 29). Needles, awls and bone points are common. The eye in a fine bone needle from Ecsegfalva 23 (see *Fig. 29.8c*) measures c. 2 mm, and would be well suited to the size of thread suggested by the width of the dental grooves present on the individuals from Ecsegfalva 23 and Tiszavasvári-Deákhalmi dűlő. This postulated size of thread is also consistent with a polished stone button from Ecsegfalva 23, with a central perforation measuring c. 2 mm (Starnini *et al.*, chapter 30). Beads are common on Early and Middle Neolithic sites in Hungary, and would need to be strung on thread, which presents another use for the material. Indeed, Grave 11 at Tiszavasvári-Deákhalmi dűlő itself contained some 34 beads with perforations on the order of 2–3 mm (Kurucz 1994, figs 4–7). Most intriguingly, the muscle attachment sites on the bones of the forearms of this individual were very pronounced, leading Kustár and Pap (1994) to suggest that she had been engaged in a repetitive activity involving the use of the hands and thumb, and in fact suggested that this could be spinning.

Direct evidence for textiles is seen in impressions on pottery, mainly from the Körös sites of Endrőd 35, 39 and 119, and Szarvas 21 and 23 (Makkay 2001). Interestingly, Makkay (2001) notes that the clay impressions show fibres spun in an S-direction (i.e. to the right), adding that flax is more stable when spun this direction, while cotton and hemp tend to spin the opposite way when dampened. This could suggest that flax was the material being used to make these textiles. In addition, what have been commonly interpreted as clay loom weights are a common find on Earlier Neolithic sites in south-eastern Europe (including a number found at Ecsegfalva 23: see chapter 28) (Makkay 1992; 2001). Both the impressions and the loom weights serve to further demonstrate the importance of textiles from the Earlier Neolithic. For the Late Neolithic, it has been noted that the designs on pottery seem to be based on textiles, and that this, together with the clothing shown on figurines, gives some indication of the importance of textiles, and of women's potential key role in the production of wealth and social power (Chapman 1997b, 136). This deserves emphasis, as frequently the importance of textile manufacture is not given sufficient recognition (e.g. Bevan 1997). This may in part be due to a historical bias in Western academia that has tended, for various reasons, to give less attention to what are perceived as women's activities (whatever the realities of weaving and thread-making in the Hungarian Neolithic). In fact, it is clear that large quantities of thread, cordage and basketry would have been essential in almost all pre-industrial societies. Where suitable plant or animal fibres were available, woven textiles are also likely to have been an important manufactured item. Tuohy (1999, 54, 57–58), for example, discusses the varied uses to which braided cordage and webbing would have been put, and the amount of material required, in Iron Age societies in Britain.

As another element in the discussion, it can be noted that there would likely have been a strong seasonal element to the working of any animal or plant fibres in the Hungarian Neolithic. The making of sinew thread could have been tied into a seasonal culling of animals. Most plant fibres (nettle, bast) would be ready to work in the spring and summer months. Flax is an exception. In Britain, flax was traditionally harvested in September, and would need to be dried and then retted and dried again, so that working the fibres into thread could not take place until the late autumn (Tuohy 1999, 62–3). Hot summers on the Great Hungarian Plain may have provided a faster maturation rate, enabling the fibres to be worked in late summer or early autumn.

Experimental work

Some preliminary experiments were undertaken in an attempt to distinguish between what were two main alternatives for materials being worked: plant thread and animal sinew. Flax thread was obtained from County Békés, Hungary, and caribou sinew thread was obtained from the Northwest Territories, Canada. These materials were not ideal, as they had been already worked into thread and did not represent the materials in their raw state. Human permanent incisors were obtained from the School of Dentistry, Queen's University Belfast. The teeth were ground down with a Dremel grinding wheel in order to replicate the flat occlusal surface of the Hungarian Neolithic grooved teeth. Flax and sinew thread were each repeatedly drawn manually back and forth across the flat occlusal surface of a separate tooth, in a transverse direction corresponding with that seen on the Ecsegfalva 23 individual.

Results are presented in the *Appendix*. Firstly it must be stated that the experiment was not continued nearly long enough to begin to produce any noticeable grooving. That being said, the preliminary results suggest it is unlikely that flax was the material being worked. Under the application of any pressure, the flax fibres readily split and fray. There seems to be little advantage to repeatedly and strongly drawing the flax fibres across the teeth. If the material has been prepared correctly, the fibres are already of equal size. Drawing sinew across the teeth, on the other hand, does effectively serve to even the thickness of the strands. Where flax was used extensively in more recent periods, the main point of drawing the fibres through the mouth was to wet them. However, it seems that even this action, repeated long enough, can leave notches on the occlusal edge of the teeth (*http://www.bbc.co.uk/history/archaeology/programme_2c.shtml).* In addition, other plant fibres may be of less equal thicknesses, and be more abrasive. The adherence of fine soil particles would also have a strong effect on abrasion. The use of plant fibres, including flax, thus cannot be excluded.

Minozzi (cited in Frayer and Minozzi 2003, 209–10) conducted far more extensive experimental work in an effort to identify the material used to produce the dental notches on LBK anterior maxillary dentition. SEM observations were made on teeth before and after 200 hours of friction, using sinew, leather and hemp fibre. Each of these materials was found to leave distinctive traces. Sinew left thin striations and furrows, producing moderate wear, although microfractures appeared along the surface. The leather string produced a polished surface with a few very thin and light parallel striations. The hemp fibre was found to be the most abrasive of the three, producing deep scratches on the tooth surface. Frayer and Minozzi (2003, 210) concluded that the wear seen on the LBK individuals from Krškany and Vedrovice most closely resemble the experimental wear left by sinew.

It can be suggested, both on the basis of Minozzi's work and the brief experiment carried out here, that sinew was possibly the more likely candidate to have been worked. Drawing sinew across the teeth is effective in producing an even thickness. Nor does the material fray and splay as seen with the flax fibres. However, the working of plant fibres cannot be excluded, and it may be that a variety of types of materials were being worked at different times and for different purposes. The impressions of Körös textiles examined by Makkay (2001) could suggest that flax was used in their manufacture.

Ethnographic accounts indicate a frequent, though by no means universal, tendency for occlusal grooving to be associated with one sex or the other, suggesting that the making of thread and basketry is often a gendered act. Frayer and Minnozi's (2003) study of the occurrence of non-dietary dental grooving provides strong support for the predominantly female involvement in thread and cordage manufacture in two LBK burial populations in eastern Europe. The LBK is closely linked in both time and space with the Hungarian AVK, and so this corresponds very well with the individuals from Ecsegfalva 23 and Tiszavasvári-Deákhalmi dűlő, both adult female. That the Late Neolithic individual from Kisköre-Gát is probably male could suggest a change in time in the gender attribution of the activity, but the sample is hardly large enough to support this conclusion. Even at Krškany and Vedrovice some males did undertake the preparation of thread and cordage leading to the formation of non-dietary dental notching. It is of course still possible that the grooves on males reflect the preparation of different materials (e.g. plant fibres vs. animal sinew), or thread intended for different uses, so that the tasks involved could still be a gendered act at some level. But such a strict gender division of activities is not necessarily to be expected in any case. Situations can arise that call for flexibility in normatively gendered activities, as is poignantly demonstrated by the following comment concerning Ishi, the 'last Yahi Indian' in California: 'He also made a lighter rope, as well as string and thread of thin deer sinew; string intended for use in sewing or for bowstrings was as fine as many strippings of it through the teeth could make it. Ishi was known to sigh over this job, for threadmaking was not only tedious, it was woman's work as much as was basketmaking' (Kroeber 1961, 187).

The location and direction of the grooves on the Hungarian Neolithic dentition suggests that it was necessary to reach a certain stage of adulthood before thread could be prepared by the method of drawing it across the occlusal surface of the upper incisors. Prior to the wearing down of the incisors, there would not be a flat surface across which to draw the fibres or sinew. This was certainly the case ethnographically among the Greenland Inuit, among whom exclusively older women (over ca. 40 years) were responsible for the preparation of sinew by pulling thin cords of animal tendon across their anterior teeth (Hart Hansen *et al.* 1991, 83). This pattern is also seen archaeologically in the area, with only older females displaying sinew grooves on their teeth. Even once a flat occlusal surface was available, working the fibres could be awkward, as they would tend to easily slip off the tooth, possibly damaging the gums in the process. As the grooves formed, the efficiency with which thread could be prepared would presumably have been greatly increased. It need not have taken many years for a flat occlusal surface to form, as the attrition rates of the anterior dentition appear to have been quite high, at least for some individuals. Indeed, the anterior dentition may have been involved in other non-dietary activities resulting in their rapid wear. The degree of wear seen on the posterior dentition of the Ecsegfalva 23A skeleton suggests an age of 25–35, although this maybe biased by the poor state of health of the teeth and numerous abscesses and caries, which could have made heavy chewing painful. In fact, the teeth of this individual appear to have been poorly developed from birth, showing poor enamel formation. The overall assessment of age taking into account multiple criteria is on the order of 35–44 years (Guba *et al.*, chapter 25). The skeleton of Grave 11 from Tiszavasvári-Deákhalmi dűlő is that of an older individual, on the order of 40–60 years (Kustár and Pap 1994).

However, this is not to say that thread could not have been worked in other ways. Frayer and Minnozi (2003) found notches in the corners of the maxillary anterior teeth, particularly the lateral incisors. This indicates a different way of working the thread, one that could begin at any age, as confirmed by the presence of a notch on a child of only some nine years age at Krškany. Only a few individuals in the two Czech Republic/Slovakian sites show occlusal grooving comparable to that seen on the Hungarian examples (Frayer and Minnozi 2003, fig. 3). And the teeth need not be used at all. For example, van der Post and Taylor (1985, fig. 78) show a Kalahari San man smoothing plant fibres with a stone in preparation for making thread.

The formation of the occlusal grooves and notches observed on the Neolithic individuals would have taken a considerable number of hours to form. The time consuming aspect of making sinew thread is emphasised by modern efforts to revive this traditional activity by some Inuit groups (Akpik and Bodenhorn 2000). This suggests that a degree of specialisation and expertise in thread-making was attained by some individuals. In fact, as noted above, Kustár and Pap (1994) independently (i.e. before the dental grooves on this individual had been recognised) suggested that the adult female of Grave 11 at Tiszavasvári-Deákhalmi dűlő could have been engaged in spinning. At the least, the overdevelopment of the muscles of the forearm does support the idea of some kind of specialised activity, though not necessarily specifically spinning. Among the indigenous peoples of the Northwest Coast of North America, some women were accorded high renown for their basketmaking and weaving skills. In fact, the activities were so specialised that it is possible that the spinner and weaver were often different individuals (Samuel 1982, 25). Of course basketry and thread were also required for a large number of day to day activities, and it is likely that all women knew these skills to some extent. But even here, as with high status objects, there would be scope for some individuals to excel, and for their tethers, straps and cords, bowstrings, fishing and harpoon line to be known as particularly strong and reliable.

Summary

Two adult females from the Hungarian AVK sites of Ecsegfalva 23 and Tiszavasvári-Deákhalmi dűlő show multiple occlusal grooves on their anterior maxillary dentition. A third individual, probably male, from the Late Neolithic site of Kisköre-Gát also displays occusal grooving. SEM analysis confirms that these grooves were the result of repeatedly drawing a fine thread-like material of approximately 1–2 mm in diameter across the teeth. Ethnographically, such grooves are associated with the manufacture of plant and/or animal fibre thread, and it is suggested that this is the explanation for the examples observed here. Lateral notches and occlusal grooves on anterior dentition have also been noted on a number of individuals, nearly all female, at two LBK sites in the Czech Republic and in Slovakia (Frayer and Minozzi 2003). This suggests a gendered task involving the manufacture of sinew thread in the Earlier Neolithic of east-central Europe (and possibly plant fibre thread as well). It is possible that in some areas, only adult women of a certain age would work thread in this way, as the anterior dentition would need to be worn down sufficiently to present a flat occusal surface on which to work. Between 10 and 20% of the adolescent/adult population may have been involved in the making of thread, and by inference at least some of the objects subsequently made employing the thread, but it is highly likely that certain individuals achieved higher levels of skill.

Further examinations of Neolithic and later dentition will need to be made to see if the patterns indicated here are sustained, or whether they are more variable through time and space.

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Appendix: Experimental results

Flax thread was obtained from County Békés, Hungary. Sinew thread was obtained from Madeline Chocolate, Community Representative for the Dogrib Nation, Yellowknife. The sinew was procured from caribou killed in fall 2002, and made into thread by M. Chocolate's mother. Human incisors were obtained from the School of the Dentistry, Queen's University Belfast. The occlusal surfaces of the incisors were ground flat with a Dremel grinding wheel to replicate the condition of the Ecsegfalva dentition. Flax and sinew threads were both already braided, which could affect the results. The flax thread and the sinew were both ca. 0.5 mm in thickness.

Experiment 1, flax thread, tooth 1, mandibular lateral incisor

Session 1 (27/04/03). Attempted to run flax thread back and forth across tooth surface. This proved very difficult, as the thread tended to slide over the surface of the tooth, and down off the edges. The thread was worn very quickly and tended to break in 1–2 minutes. This occurred particularly on the edges of the tooth (which were smoothed so as not to be especially sharp after the grinding process). The thread itself tends to flatten and splay on the tooth quite rapidly.

Session 2 (04/05/03). Edges of the tooth were ground smoother to prevent fraying seen in first session. However, this had little effect on the process, and again the flax thread frayed and broke in less than five minutes. Of course, there would be no need to repeatedly work the same section of fibre once it was separated into strands and wetted; this was done here to determine the effects on the tooth. Nevertheless, aside from wetting, there did not seem to be any benefit to be derived from drawing the flax across the teeth. This may, however, be partly to due with the fact that prepared thread was being used rather than raw fibres.

Experiment 2, caribou sinew, tooth 2, mandibular canine

Session 1 (27/04/03). Similar difficulties were encountered as with the flax thread. The sinew thread did tend to last slightly longer, but each section still broke in under five minutes. This occurred though the shaving off of filaments, again, particular on the edges of the tooth. This would be very effective in thinning down sinews and achieving an even thickness prior to braiding.

Session 2 (4/5/03). Edges of the tooth were ground smoother. This helped considerably, and it was possible to work with one braided sinew thread for an hour before it was broken into fragments too small to use (again, as with flax, when preparing sinew for braiding there would be no need to work the same section of fibre for such an extended period; this was done here to conserve a limited supply of raw materials, and to examine the effects of the sinew on the tooth). No changes could be seen on the tooth. It was difficult to maintain the movement of the thread in place on the tooth, and it slipped off frequently. If upwards pressure was being applied by a living individual performing this task, such slippage could presumably lead to repeated cuts on the gums and upper lip.

The difficulty of working both materials suggests the possibility that 'starter' grooves were first intentionally made on the occlusal surfaces of the incisors. Alternatively the tongue may have been used to help hold the thread in place.

Dental health in Early and Late Neolithic Hungary: dietary implications

Rick Schulting, Antónia Marcsik and *Ildikó Pap*

Introduction

One of the key questions for the Earlier Neolithic in Hungary, and indeed across Neolithic Europe as a whole, is the balance between various elements of the subsistence economy. This question is notoriously difficult to address. We know from food remains on Hungarian Neolithic sites that a wide range of resources were used, including wild game, fish, freshwater shellfish, domesticated sheep, cattle and pig, and cereals. It further seems clear that domestic sheep are overwhelmingly dominant in the faunal assemblage (see Bartosiewicz, chapter 14). Cereals also appear to have played an important role in the diet (Bogaard *et al.*, chapter 23).

Dental health provides an additional line of evidence for prehistoric human diet that can complement traditional analyses of archaeological floral and faunal assemblages, and newer biochemical approaches, both on human bone and on potsherd residues. In particular, data on the incidence of caries can inform on the relative amounts of carbohydrate in the diet (Turner 1979; Powell 1985; Larsen *et al.* 1991). There are other factors involved, so that a simple equation linking plant foods in the diet with the incidence of caries cannot be made; groundwater composition (e.g. fluorine inhibits caries formation), food preparation techniques and oral hygiene are all relevant. An intra-regional comparison does provide control over some of these factors (e.g. groundwater), making temporal trends and gender-based differences more susceptible to interpretation.

While stable isotope analysis is a powerful means of exploring certain aspects of diet (Schoeninger and Moore 1992), the technique is less well-suited to an assessment of the contribution of C3-pathway plant foods in the diets of individuals living in an ecosystem with C3-dominated plant biomass. Measurements on bone collagen (which is by far the component of bone most commonly measured, and comprises the dataset available for Neolithic Hungary) take into account only the protein component of the diet (Ambrose and Norr 1993). In general, plant foods have significantly less protein than animal foods (meat and fish), and their contribution is easily swamped as mathematical modeling demonstrates (e.g. Schulting 1998a; Hedges 2004). The problem is exacerbated by the reduced discrimination seen in $\delta^{15}N$ measurements compared to $\delta^{13}C$. In other words, with $\delta^{13}C$, marine and terrestrial sources differ by approximately 8 or 9‰, while terrestrial animal and plant sources differ in their $\delta^{15}N$ ratios by only 2–4‰. Interpretation can only be undertaken with confidence using averages derived from larger samples. The availability of new faunal isotope values (Pearson and Hedges, chapter 22) greatly increases the ability to interpret the human values, though gaps remain. The means for the faunal values that are available, while generally behaving as predicted, show a substantial degree of variability (chapter 22; *Figs 22.1–3*).

Many Körös and AVK sites in Hungary have yielded cereal remains in varying quantities (Bogaard *et al.,* chapter 23). Cereal impressions have also been found in pottery (Hartyányi and Nováki 1975b). Other plant foods are rare, however, despite intensive sampling and flotation over three seasons at Ecsegfalva 23. This extends to a near absence of hazelnut shells, which are ubiquitous on Mesolithic and Neolithic sites in north-west Europe (Zvelebil 1994). Thus it is a reasonable assumption that the caries rates discussed here are largely attributable to carbohydrates derived from cereals, and so serve as a proxy for their use (keeping in mind the caveats noted above regarding food preparation techniques and oral hygiene). More generally, the presence of Earlier Neolithic agricultural practices is also supported by evidence for clearance and episodes of land degradation seen in pollen and sediment evidence (Willis 1997; Willis *et al.* 1998).

Dental pathology: caries rates, abscessing and ante-mortem tooth loss

Caries rates for the Hungarian Neolithic have previously been investigated, but very small sample sizes available at the time severely limited what could be said (e.g. Schranz and Huszár 1962; Szathmáry 1983b; see literature surveys in Tóth 1970 and Pap 1989). Most studies that deal with the period do not differentiate between the Earlier and Later Neolithic. In one study, Molnar and Molnar (1985) only began their analysis of caries rates with the Late Neolithic. Other studies have focused on the Bronze Age and later periods (Farkas 1977; Frayer 1984; Pap 1986; Rega 1995; Ubelaker and Pap 1996). There are also a small number of individual accounts, such as those of Bartucz (cited in Tóth 1970, 37), who reports the presence of seven caries in a female skeleton disinterred at Büdöspest cave. However, the dating of finds such as these is often open to question.

While sample size could hardly be said to be that much improved, it is at least sufficient to offer some preliminary observations. For the present study, a total of 24 adults (427 teeth) were attributed to the Earlier Neolithic (Körös and AVK), and 44 adults (795 teeth) to the later Neolithic. Some of these attributions may be problematic, as shown by Whittle *et al.*'s (2002) dating programme, but the majority are likely to be correct. A few individuals from Vésztő-Mágorihalom are likely to be of Copper Age date. A small number of subadults were also examined, but have been excluded from discussion here, which focuses on the adult dentition. Of the greatest interest is the overall incidence of caries in the Earlier Neolithic, and how this compares both to the later Neolithic and subsequent periods in Hungary itself, and to other regions of Neolithic Europe. Another question of some interest is whether gender-based differences can be detected within the Earlier and/or Later Neolithic.

Caries were scored on a simple presence/absence basis. Very small pits and fissures were not scored as carious unless destruction of the tooth was clearly evident. The results are summarised in *Tables 26.2–3.* The overall incidence of caries is 6.1% for the Earlier Neolithic and 7.2% for the later Neolithic. The incidence of caries in the posterior dentition only (i.e. all molars and premolars; anterior teeth are far less susceptible to caries and are sometimes excluded when calculating rates) for the Earlier Neolithic is 8.6%, compared to 10.7% for the later Neolithic. None of these differences is statistically significant at the .05 confidence level (used for all references to statistical significance in this chapter), and so it is interesting to note that there is no indication from this dataset that the importance of cereals or other cariogenic plant foods increased through the Neolithic. Nor is there any sense that caries rates were lower in those individuals attributed to the Early Neolithic Körös (8.9%) period compared with the AVK (5.6%). Unfortunately what is currently lacking is an indication of caries rates in the preceding Mesolithic period. A single individual from Maroslele-Pana directly dated to the Mesolithic (Whittle *et al.* 2002) displayed no caries, but only five teeth were present *(Table 26.2).* Without this baseline it is difficult to assess the impact of the appearance of cereals in the region. It seems, however, that in terms of plant

Table 26.2. Hungarian Early/Middle Neolithic teeth

Site	Burial no.	Age	Sex	Caries	All teeth	Ant. teeth	Post. teeth	Abscess	AM loss	Tooth sockets
Mesolithic										
Maroslele-Pana	7	adult	M	0	5	0	5	0	0	9
Early/Middle Neolithic										
Endrőd 35	3.1	young adult	M	0	13	4	9	0	0	16
Endrőd 36	2	young adult	M	0	22	8	14	0	0	26
Hódmezővásárhely-Kotacpart	131	young adult	M	4	13	3	10	0	0	16
Tiszaluc	B9	young adult	M	1	32	12	20	0	0	16
Tiszavasvári-Deákhalmi dűlő	7	young adult	M	0	17	3	14	0	0	20
Tiszavasvári-Deákhalmi dűlő	9	young adult	M	0	21	9	12	0	0	22
Hódmezővásárhely	3/8, 112	young adult	I	0	16	0	16	0	0	32
Maroslele-Pana	3	young adult	I	1	9	0	9	0	0	16
Szarvas 8, Szappanos	4.3b	young adult	I	0	9	0	9	0	0	16
Szegvár-Táncsics utca	2	young adult	F?	1	12	1	11	0	0	16
Dévaványa-Katonaföldek	2.1	young adult	F	1	6	0	6	0	0	6
Ecsegfalva 23A	B1	young adult	F	4	30	12	18	2	2	32
Hódmezővásárhely-Kotacpart	132	young adult	F	2	10	0	10	2	0	28
Mogyorós		young adult	F	2	7	2	5	3	1	15
Sarkadkeresztúr-Csapháti		young adult	F	0	32	12	20	0	0	32
Szarvas 23	1	young adult	F	0	16	6	10	0	0	16
Tiszavasvári-Deákhalmi dűlő	8	young adult	F	0	25	6	19	0	0	32
Tiszaluc	B5	mid adult	M?	1	29	11	18	0	0	32
Endrőd 5, Csongrád		mid adult	M	1	19	6	13	3	0	26
Hódmezővásárhely-Kotacpart	130	mid adult	M	2	24	6	18	0	0	27
Deszk I	6	mid adult	F?	2	18	7	11	1	0	32
Tiszavasvári-Deákhalmi dűlő	11	mid adult	F?	4	26	11	15	8	2	32
Deszk I	5	mid adult	F	0	20	6	14	0	0	32
Mezőtúr-Berettyó		adult	F	0	1	1	0	0	0	1

Table 26.2. Continued

Site	Burial no.	Age	Sex	Caries	All teeth	Ant. teeth	Post. teeth	Abscess	AM loss	Tooth sockets
Maroslele-Pana	1	adol.	I	0	4	1	3	0	0	16
Szarvas 8, Szappanos	4.4	adol.	F?	0	5	1	4	0	0	6
Szarvas 8, Szappanos	4.2	adol.	F?	0	10	2	8	0	0	14
Maroslele-Pana	5	adol.	F	0	24	8	16	0	0	30
Szegvár-Tűzköves		adol.	F	0	7	0	7	0	0	14
Total number of adults (excluding adolescents) =				24						
Total no. of occurrences =				26	427	126	301	19	5	539
No. of individuals affected =				13				6	3	
% teeth/sockets affected =					6.1%		8.6%	3.5%	0.9%	
% individuals affected =				54.2%				25.0%	12.5%	
male % teeth/sockets affected =					4.7%			1.5%	0.0%	
female % teeth/sockets affected =					7.9%			5.8%	1.8%	
Körös % teeth/sockets affected =					8.9%			3.2%	0.4%	
AVK % teeth/sockets affected =					5.6%			3.6%	2.2%	
young adult =					5.5%			2.0%	0.8%	
middle adult =					7.4%			6.6%	1.1%	

food consumption (presumably predominantly cereals), whatever the specific balance between plant and animal resources was, it appears to have been part of a pattern established very quickly and then maintained at least at a general level throughout the Neolithic.

There are published data in the literature with which to broaden the chronological perspective within Hungary. Molnar and Molnar (1985) report widely varying caries rates ranging from 11.7% in a small Late Neolithic sample (16 individuals from Vésztő-Mágorihalom and Kisköre-Gát, which considerably overlaps the dataset presented here) to 8.1% in the Copper Age and c. 9% in the Bronze Age as a whole *(Table 26.4; Fig. 26.9)* (these rates are for all adult teeth, rather than just posterior teeth). Reported medieval caries rates range from 6.4 to 12.1% (Frayer 1984; Pap 1986). Perhaps contrary to initial expectations, overall there is no clear temporal trend in the available caries data for Hungary (cf. Tóth 1970, 61), although period coverage is uneven.

There is a surprising degree of variation in the caries rates that have been reported for the same periods. Thus while Molnar and Molnar (1985) report a rate of 3.6% for the Early Bronze Age, Rega (1995; see also Farkas 1977) provides a considerably higher caries rate of 8.5% for the Early Bronze Age site of Mokrin. This suggests, perhaps not surprisingly, that local variation is being masked by considering only average figures. This is also seen in the Late Neolithic dataset discussed here, where Vésztő-Mágorihalom shows a significantly higher incidence of caries than most other Late Neolithic sites, though the former does likely include some Copper Age individuals *(Table 26.3)*. A more serious methodological problem that may be partly to blame for the apparent discrepancies arises when different investigators using different criteria to score caries (cf. Ubelaker and Pap 1996). Tóth (1970) also points to various inconsistencies between researchers examining the same material for caries rates. Clearly this is a problem requiring resolution if the results are to be treated with confidence.

In a wider European context, the Hungarian Neolithic caries rate of c. 6–7% reported here is considerably higher than those seen in the Earlier Neolithic of north-west Europe, which range from c. 1.5% in Denmark and Sweden, to c. 2.4% in Britain and up to c. 4% in France (Meiklejohn *et al.* 1984; 1988; Persson and Persson 1984; 1988; Bennike 1985; Brothwell 1985; Schulting

Table 26.3. Hungarian Late Neolithic teeth

Site	Burial no.	Age	Sex	Caries	All Teeth	Ant. teeth	Post. Teeth	Abscess	AM Loss	Sockets
Aszód-Papiföldek	68.23.13	old adult	M?	2	9	3	6	0	1	9
Hódmezővásárhely-Kökénydomb	162	young adult	M?	0	22	10	12	1	0	23
Kisköre-Gát	68.29.30	young adult	M?	0	27	10	17	1	0	29
Kisköre-Gát	68.29.29	mid adult	M?	5	17	9	8	1	3	18
Aszód-Papiföldek	68.23.15	young adult	M	0	26	8	18	0	0	32
Aszód-Papiföldek	68.23.21	young adult	M	0	19	9	10	0	0	26
Aszód-Papiföldek	68.23.20	mid adult	M	0	29	11	18	3	1	32
Hódmezővásárhely-Gorzsa	4057	old adult	M	0	0	0	0	3	8	10
Vésztő-Mágorihalom	39/8420	old adult	M	9	28	8	20	1	1	30
Vésztő-Mágorihalom	4/7964	adult	M	0	27	11	16	0	0	27
Vésztő-Mágorihalom	44/8575	adult	M	1	28	8	20	0	0	28
Vésztő-Mágorihalom	13/7974	adult	M	0	31	12	19	0	0	31
Vésztő-Mágorihalom	36/8417	adult	M	3	29	9	20	0	0	29
Vésztő-Mágorihalom	34/8415	adult	M	0	15	1	14	0	1	18
Aszód-Papiföldek	68.23.18	young adult	I	1	22	5	17	0	0	27
Aszód-Papiföldek	68.23.30	old adult	I	0	2	0	2	0	2	8
Hódmezővásárhely-Gorzsa	4054	young adult	I	1	6	0	6	5	1	30
Vésztő-Mágorihalom	42/8423	adult	I	0	4	1	3	1	0	4
Vésztő-Mágorihalom	30/8411	adult	I	1	1	0	1	0	0	1
Vésztő-Mágorihalom	16/8398	adult	I	5	12	5	7	0	2	14
Vésztő-Mágorihalom	40/8421	adult	I	0	13	2	11	0	0	13
Vésztő-Mágorihalom	3/?	adult	I	1	25	8	17	0	0	25
Vésztő-Mágorihalom	37/8418	adult	I	5	13	2	11	0	2	16
Vésztő-Mágorihalom	43/8574	adult	I	3	9	2	7	2	4	12
Vésztő-Mágorihalom	35/8416	adult	I	4	4	2	2	0	3	8
Vésztő-Mágorihalom	41/8573	adult	I	0	23	10	13	0	2	23
Aszód-Papiföldek	68.23.7	young adult	F?	0	25	7	18	0	0	31
Aszód-Papiföldek	68.23.17	young adult	F?	0	24	7	17	0	0	24
Aszód-Papiföldek	68.23.19	young adult	F?	0	11	4	7	0	0	15
Aszód-Papiföldek	68.23.25	young adult	F?	0	10	3	7	0	0	21
Aszód-Papiföldek	68.23.4	mid adult	F?	1	8	3	5	1	0	13
Aszód-Papiföldek	68.23.6	mid adult	F?	0	8	4	4	0	0	13
Kisköre-Gát	68.29.31	old adult	F?	1	13	4	9	1	0	15

Table 26.3. Continued

Site	Burial no.	Age	Sex	Caries	All Teeth	Ant. teeth	Post. Teeth	Abscess	AM Loss	Sockets
Vésztő-Mágorihalom	8413	young adult	F?	0	28	9	19	0	0	32
Vésztő-Mágorihalom	7963	young adult	F?	1	22	7	15	0	0	31
Aszód-Papiföldek	68.23.11	young adult	F	1	2	0	2	0	0	8
Aszód-Papiföldek	68.23.23	young adult	F	0	26	7	19	0	0	32
Hódmezővásárhely-Gorzsa	4058	old adult	F	0	0	0	0	0	11	11
Hódmezővásárhely-Gorzsa	4056	adol.	F	0	28	12	16	0	0	28
Hódmezővásárhely-Kökénydomb	9616	young adult	F	0	26	6	20	0	0	32
Hódmezővásárhely-Kökénydomb	159	young adult	F	0	28	8	20	0	0	29
Hódmezővásárhely-Kökénydomb	161	young adult	F	0	26	11	15	1	1	32
Kisköre-Gát?	68.21.11	young adult	F	0	19	6	13	0	0	23
Vésztő-Mágorihalom	7969	young adult	F	2	27	9	18	1	0	30
Vésztő-Mágorihalom	6/7968	old adult	F	6	23	9	14	5	4	23
Vésztő-Mágorihalom	4/7966	adult	F	5	22	8	14	0	2	24
Vésztő-Mágorihalom	43/8574	adult	F	1	6	0	6	2	4	9
	Total number of adults =			47						
Includes Hódmezővásárhely-Gorzsa #4057 and 4058	Total no. of occurrences =			59	823	270	553	29	53	999
	No. of individuals affected =			21				15	18	
	% teeth/sockets affected =				7.2%		10.7%	2.9%	5.3%	
	% individuals affected =			44.7%				31.9%	38.3%	
Excludes Hódmezővásárhely-Gorzsa #4057 and 4058	Total no. of occurrences =						26	34	978	
	% teeth/sockets affected =							2.7%	3.5%	
	male % teeth/sockets affected =				6.5%			2.9%	4.4%	
	female % teeth/sockets affected =				4.7%			2.3%	4.6%	
	young adult =				1.5%			1.8%	0.4%	
	middle adult =				9.7%			6.6%	5.3%	
Includes Hódmezővásárhely-Gorzsa #4057 and 4058	old adult =				24.0%			9.4%	25.5%	
	COMBINED Neolithic =			85	7.9%	1070		3.1%	3.8%	1538

Table 26.4. Caries rates through time in Hungary

Time period	Caries rates	Source
Earlier Neolithic	6.09%	this study
Later Neolithic	7.17%	this study
Later Neolithic	11.73%	Molnar and Molnar 1985
Copper Age	8.11%	Molnar and Molnar 1985
EBA	3.85%	Molnar and Molnar 1985
EBA Mokrin	8.50%	Rega 1995
MBA	3.15%	Ubelaker and Pap 1996
LBA	14.66%	Molnar and Molnar 1985
Iron Age	4.20%	Schranz and Huszár (in Tóth 1970)
Medieval (9–12th century)	8.80%	Frayer 1984; Pap 1986

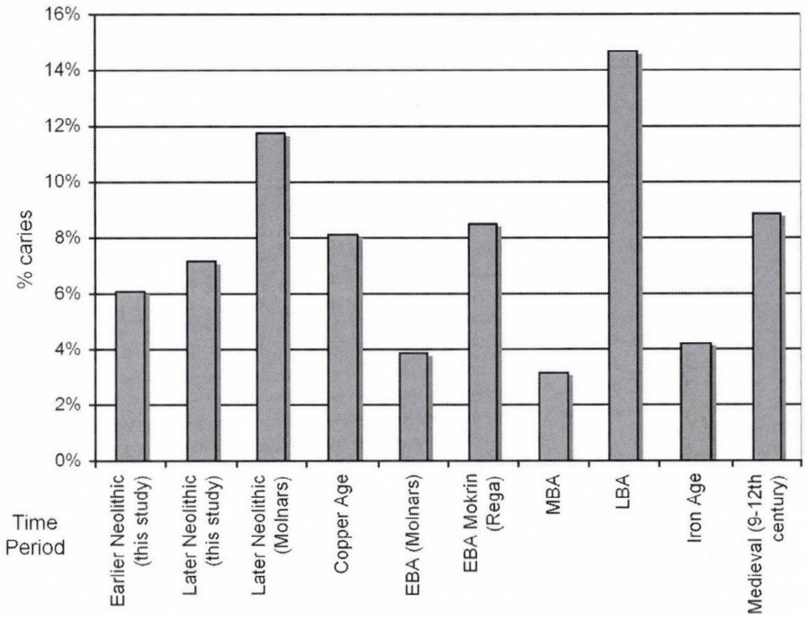


Fig. 26.9. Comparison of caries rates (% of all teeth) through time in Hungary. Note the considerable variation in the results of different researchers/sites for the same periods. Sources: see *Table 26.4*

1998b). Caries rates tend to be substantially higher around the Mediterranean and in southern Europe, up to c. 10% in the Portuguese Neolithic, most likely due to the presence of sugar-rich foods such as honey and figs (Meiklejohn *et al.* 1984; 1988; Meiklejohn and Zvelebil 1991; Lubell *et al.* 1994). It is unlikely that such foods would be an important factor in the Hungarian Neolithic, suggesting that cereals are in fact largely responsible. Again, it is necessary to be more wary of such inter-regional comparisons of caries rates, as there are many complicating factors that can enter into the equation.

In an even broader context, a cross-cultural sample of agricultural societies compiled by Turner (1979) provides an average caries rate of c. 8.6% for 31 agricultural societies, compared with c. 4.5% for societies with a mixed economy, and c. 1.7% for fisher-hunter-gatherers. There is a wide range of variation around these means, but taken at face value it may be suggested that the Neolithic Hungarian caries rates are intermediate between groups with an agricultural economy and those with a mixed farming/pastoral subsistence regime.

Regarding differences between the sexes in the present sample, for the Earlier Neolithic rates for both males and females are similar *(Tables 26.2–3)*. Females show a somewhat higher incidence both overall and for the posterior dentition. For the later Neolithic this trend is reversed, with males exhibiting caries rates marginally higher than females. In neither case do the differences reach statistical significance. Molnar and Molnar (1985) also report no differences between the sexes in their small Late Neolithic Hungarian sample, although they do not provide details of the comparison. At the Early Bronze Age site of Mokrin, females show significantly higher caries rates than males (10.8% vs. 6.1%, respectively) (Rega 1995). For the Neolithic sites considered here, a strong pattern is seen in the increasing frequency of caries with older individuals, both male and female. This is particularly evident in the later Neolithic, where the differences between young, middle and old adults are all statistically significant.

The Earlier and Later Neolithic samples show similar frequencies of abscessing, 3.5% and 2.9%, respectively. Molnar and Molnar (1985) report a lower but comparable incidence of 2% for their Late Neolithic sample. The origins of many of these abscesses can be attributed to caries, so that actual caries rates are likely to be somewhat higher than reported above. While this applies to all periods considered in the above discussion, it apparently does not apply equally, as the reported incidence of abscessing in the Copper and Bronze Age is lower (< 1%) (see below). The effect of this is to increase the incidence of caries in the Neolithic relative to that of the Copper/Bronze Age. Rates of ante-mortem tooth loss (AMTL) are low in the Earlier Neolithic (0.9%) but rise considerably higher in the Late Neolithic (5.3%), although this is strongly influenced by the presence of two older, largely edentulous, adults from the site of Hódmezővásárhely-Gorzsa; removing these from the calculations lowers this figure to 3.5%. Molnar and Molnar (1985) do not provide AMTL figures, but Ubelaker and Pap (1996) report an incidence of 4.7% for a large burial population at the Middle Bronze Age site of Tiszafüred.

Somewhat unexpectedly, the majority of the dental indicators in a four period comparison (Neolithic, Copper, Bronze, and Iron Ages) suggest greater morbidity in the Neolithic than in later periods. For example, Ubelaker, Pap and Gaver, (unpublished manuscript) and Ubelaker and Pap (unpublished manuscript) report the percentage of permanent teeth with carious lesions as decreasing significantly from 6.3% in the Neolithic to 2.3% in the Copper Age, 3.2% in the Bronze Age and 3.7% in the Iron Age. The frequency of alveolar abscessing was highest of all samples in the Neolithic (2.6%). This frequency decreased in later samples to 0.8% in the Copper Age, 0.4% in the Bronze Age, and 1.5% in the Iron Age. The trends were very similar for both males and females. The data presented and discussed here are in broad agreement with these trends (not surprisingly, as, for the Neolithic, they include much of the same material).

In addition, the above authors found that the percentage of dental hypoplasia in the permanent teeth of males decreased through time. In the Neolithic sample, 2.2% of all teeth examined from adult males presented evidence of hypoplasia. This value was reduced to only 0.3% in the Copper Age, 0.5% in the Bronze Age and then it increased slightly to 1.8% in the Iron Age. The similarly related condition of antemortem loss of teeth decreases from 6.0% in the Neolithic to 5.2% in the Copper Age, 4.7% in the Bronze Age and 5.0% in the Iron Age (Ubelaker, Pap and Gaver, unpublished manuscript; Ubelaker and Pap unpublished manuscript).

A comparison with the biochemical data

Caries rates observed in Hungary are relatively high in the context of the European Neolithic, suggesting a significant input of carbohydrates and/or simple sugars into the diet, one which did not vary significantly from the Early to Late Neolithic. The available stable isotopic data also do not appear to show any clear chronological trend within the Neolithic (Pearson and Hedges, chapter 22; Richards in Whittle *et al.* 2002). Stable nitrogen values are high relative to the contemporary fauna, suggesting the dominance of animal-derived protein. This would tend to mask the contribution of plant proteins. However, of particular note are the elevated $\delta^{13}C$ values of some individuals attributed to both the Early and Late Neolithic. In the absence of a source of marine protein, this may be the result of a C4 plant (presumably millet, though archaeobotanical evidence for this is minimal) in the diet (Pearson and Hedges, chapter 22).

Taking another approach, Pais and Tóth (1991; 1996) use strontium and zinc trace element analysis of human remains to suggest a trend of increasing meat consumption through time in the Carpathian Basin, with the Neolithic showing relatively low meat consumption. There is no support for this temporal trend in the caries data, although it is not necessarily the case that increased meat consumption will reduce caries rates, provided that carbohydrates still form a significant component of the diet. In addition, trace element data must be approached cautiously, as they are susceptible to post-depositional contamination (Nelson *et al.* 1983; Hancock *et al.* 1989; Ezzo 1994). Stable isotope analysis is not affected to the same degree (or at least can be more easily assessed for contamination), and Pearson and Hedges' data show that animal protein was a major component of Hungarian Neolithic diet from the outset.

The above discussion refers to general population trends. An attempt was made to compare caries and isotopic data at the level of the individual, but this was hampered by a number of factors, foremost being the small overall sample size available, exacerbated by the poor collagen preservation seen in a number of key individuals (chapter 22; *Figs 22.2–3*). Thus, no meaningful comparison can be made at this time between those individuals exhibiting either more or fewer caries, and their stable isotope values. Further work will need to be undertaken to bring the various lines of evidence together.

Summary

Caries rates in Neolithic Hungary are found to be on the order of 6.1% in the Early Neolithic and 7.2% in the Late Neolithic (for a combined Neolithic caries rate of 7.9% of teeth affected). This is broadly comparable to later periods, and suggests that cariogenic foods (i.e., carbohydrates, presumably mainly derived from cereals) made a significant impact from the beginning of the Neolithic, though this conclusion remains tentative without a Mesolithic baseline for comparison. In the wider European Neolithic context, caries rates from Hungary are higher than those seen throughout north-west Europe, but lower than those seen in southern Europe, though in the latter case sugar-rich wild foods are likely implicated. The incidence of abscessing and antemortem tooth loss is quite high in the Neolithic relative to later periods. Comparisons with stable isotopic data have only been undertaken at a general level, but it seems that animal protein was consumed in sufficient quantities to mask the contribution of plant proteins.

Acknowledgements

Elizabeth Rega generously provided data on Mokrin from her unpublished PhD thesis, for which the authors express their appreciation. Jessica Pearson provided useful critical comments. The School of History and Archaeology at Cardiff University provided support for this research.

Chapter 27

THE POTTERY FROM ECSEGFALVA 23

Krisztián Oross

'Cleanliness and orderliness were not the finest virtues of prehistoric man settling by the River Aranka.'
(Gyula Kisléghi Nagy, commenting on the Early Neolithic settlement at Óbesenyő)[1]

Introduction

The Körös, Starčevo and Criş cultures form one of the best known prehistoric culture provinces of the Carpathian Basin. The first articles describing the finds of the Körös culture were published in the late nineteenth century (Pulszky 1882, pl. II. 2–3, 7?; Milleker 1893; Reizner 1899, 11).[2] This can in part be attributed to the abundance of Körös sites, and in part to the growing interest in the past, the archaeological activity of enthusiastic local intellectuals[3] and the foundation of municipal museums. János Banner systematically investigated several major sites in the Hódmezővásárhely area in the interwar period, whose finds he published in a series of studies (Banner 1929; 1931b; 1932; 1934; 1935; 1936; 1937). Following the culture's initial classification as the Tisza III period (Banner 1932), the exact relative chronology of the Körös assemblages was finally established (Banner 1935, 97–98, 121–22; Tompa 1937, 46–47; Kutzián 1944, 141), and it also became clear that these finds represent the earliest farming communities in the Carpathian Basin. The first comprehensive monograph was written by Ida Kutzián (Kutzián 1944; 1947). Following a roughly decade-long standstill after World War Two, new advances in research on the Körös culture were signalled by Nándor Kalicz's field surveys in the Tiszazug region (Kalicz 1957, 16–27, 84–85, 87), and János Makkay's overview of the prehistoric finds from the Berettyó valley in County Bihar (Makkay 1957, 26–27). The sites in the southern part of the Great Hungarian Plain were investigated by Ottó Trogmayer (Trogmayer 1964; 1966; 1968b; 1968c; 1968d; 2003; 2004). Pál Raczky published several find assemblages from the Szolnok area (Raczky 1976; 1978; 1980; 1983a; 1983b; Kalicz and Raczky 1980–81). Remains of a Körös house with upright walls were first excavated at Tiszajenő-Szárazérpart (Selmeczi 1969; Tringham 1971, 86, fig. 14c–d; Raczky 1976, 171–72, figs 1–2). Countless Early Neolithic sites were identified during the extensive field surveys conducted as part of the Hungarian Archaeological Topography project (Ecsedy *et al.* 1982; Jankovich *et al.* 1989; Jankovich *et al.* 1998). In 1982, Makkay estimated that the number of Körös-Starčevo sites in the Tisza valley totalled 484 (Makkay 1982b, 113). In addition to his theoretical studies on various issues of the Körös-Starčevo culture, Makkay conscientiously published the pottery and other finds from the sites he had excavated

(Makkay 1965; 1969; 1981; 1982b, 26–46; 1984; 1987; 1990b; 1992; 1996; 2000). Raczky discussed the culture's chronology and Balkanic contacts, with an emphasis on the late Körös phase (Raczky 1988, 14–32; 1989). New advances in more recent years include the studies written by Róbert Kertész and Pál Sümegi from a palaeoecological perspective (Sümegi and Kertész 1998; Kertész and Sümegi 1999; 2001). Alasdair Whittle and his colleagues published a series of new radiocarbon dates. Most of the samples were taken from well known and extensively investigated Körös settlements, and these dates provide secure anchors for the absolute chronological position of these sites (Whittle *et al.* 2002). The major milestones in the research of the Körös culture have been described in detail (Makkay 1969, 13–16; Raczky 1988, 14–15) and thus I will only discuss a few important points here.

The unfailing interest in the earliest Neolithic culture in Hungary does not mean that there are no unresolved issues as regards the research of the Körös culture. The culture's internal periodisation is still uncertain in spite of the many efforts in this field (discussed at greater length below). While the absolute chronology of the Körös complex has been established, only a handful of radiocarbon dates are available for most sites. Even though longer series have been published more recently, these come from a few select sites. The culture's internal periodisation is still controversial and the absolute chronology of a particular pottery style is also uncertain. Very often, only a preliminary report is available for extensively investigated sites or the finds have not been published at all.[4] This chapter offers a description of the Early Neolithic pottery finds excavated at Ecsegfalva between 1999 and 2001, followed by a discussion of the settlement's chronological position and the chronology of the Körös culture.[5]

The statistical analysis of the pottery finds

General statistical data

The pottery finds excavated at Ecsegfalva 23 between 1999 and 2001 were counted twice for the general statistical evaluation: once before restoration (labelled as 'single' fragments in the statistical table), and once after restoration (labelled 'joined' fragments in the statistical tables). Finds of the Körös culture, the Alföld Linear Pottery culture (Alföldi vonaldíszes kerámia kultúrája, further AVK), the culturally unattributable Early or Middle Neolithic (Körös and AVK) and the post-Neolithic finds were treated separately. The results of the statistical analyses are shown in *Table 27.1.*

A comparison of the single and joined pottery fragments shows that the quantity of restorable pottery was negligible in the assemblages post-dating the Körös culture. The Körös pottery was heavily fragmented and the number of restorable pieces was low. The number of pottery finds recovered from each trench varied considerably *(Table 27.2).*

Table 27.1. Distribution of single and joined pottery fragments in the ceramic inventory from Ecsegfalva 23

	Körös		**Körös/AVK**		**AVK**		**Post-Neolithic**		**Total**	
	single	**joined**	**single**	**joined**	**single**	**joined**	**single**	**joined**	**single**	**joined**
Ecsegfalva 23, Trench A	846	803	374	373	655	648	30	30	1,905	1,854
Ecsegfalva 23, Trench B	8,853	8,517	12	12	8	8	50	49	8,923	8,586
Ecsegfalva 23, Trench C	1,606	1,547	2	2	0	0	4	4	1,612	1,553
Ecsegfalva 23, total	**11,305**	**10,867**	**388**	**387**	**663**	**656**	**84**	**83**	**12,440**	**11,993**

Table 27.2. Percentage of joined sherds in the ceramic inventory from Ecsegfalva 23

	Körös		Körös/AVK		AVK		Total	
	joined	%	joined	%	joined	%	joined	%
Ecsegfalva 23, Trench A	803	7.39	373	96.38	648	98.78	1,854	15.46
Ecsegfalva 23, Trench B	8,517	78.37	12	3.10	8	1.22	8,586	71.59
Ecsegfalva 23, Trench C	1,547	14.24	2	0.52	0	0	1,553	12.95
Ecsegfalva 23, total	**10,867**	**100**	**387**	**100**	**656**	**100**	**11,993**	**100**

The percentage frequencies of restored pottery finds clearly show that 71.59 per cent of the pottery finds was recovered from Trench B. This dominance is even more striking in the case of the Körös finds since 78.37 per cent of all the Körös pottery was recovered from this trench, the largest of the three. In contrast, the AVK ceramic finds were predominantly recovered from Trench A; 98.78 per cent of the AVK wares came from this trench, as well as 96.38 per cent of the unattributable Körös/AVK finds.

Statistical analyses of pottery decorations and carinated vessel forms

The statistical analysis of the pottery finds also includes an examination of the frequencies of various ornamental motifs and the occurrences of carinated vessel forms. In addition to determining the frequencies compared to the total pottery sample, we also examined the stratigraphic context from which the finds were recovered. Since over 78 per cent of the restored Körös pottery came to light in Trench B, it seemed reasonable to analyse the pottery finds from this trench in greater detail. This seemed all the more instructive because Trenches A, B and C were not contiguous and thus the correlation of the levels distinguished in each trench would have raised several problems.

The team excavating the site[6] distinguished and documented a layer sequence made up of several hundred 'contexts' (see chapter 9). The stratigraphic position of these 'contexts' relative to each other was also recorded. The correlation of the examined pottery finds with the different 'contexts' in this matrix would have resulted in a chaotic and confusing system owing to the high number of individual 'contexts'. We therefore created a simplified stratigraphic system, made up of ten sub-levels within the five main levels distinguished in Trench B, based on the matrix incorporating the observations made during the excavation and the stratigraphic position of the 'contexts' relative to each other. Each 'context' in the matrix of Trench B could be associated with one particular sub-level, as shown in *Table 27.3.*

Taking the entire ceramic material from Trench B after restoration as 100 per cent, we could determine the pottery percentages, as well as the frequencies of pottery decorations and vessel forms for each sub-level. A comparison of the frequencies of ornamentation types and vessel forms in each sub-level relative to the entire ceramic assemblage revealed whether a particular ornamentation and/or form occurred in the entire sequence, whether they were under- or over-represented in a sub-level, and whether they were evenly distributed.

No statistics were made of the horizontal distribution of pottery in Trench B. The distribution frequencies of various decorated and carinated pottery types nonetheless indicate that there was a significant concentration of pottery in the sub-levels of the upper occupation level in the trench's North Extension (see chapter 9). 'Contexts' 430, 445 and 464 of sub-levels 2.1, 2.2 and 2.3 stand out by the richness and the diversity of their finds.

Table 27.3. Excavation matrix with the 'contexts' of Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Ecsegfalva 23, Trench B, 'contexts'
1. topsoil	1.1	300, 422, 423
2. upper occupation level	2.1	301, 302, 303, 305, 310, 312, 430, 431, 435, 436, 437, 438, 440, 451, 452, 453, 454, 455, 456, 463, 467
	2.2	304, 305, 438, 445, 452, 453, 454, 455, 456, 457, 458, 467
	2.3	305, 307, 308, 309, 311, 313, 314, 340, 344, 354, 355, 360, 361, 362, 363, 364, 365, (366), 367, 375, 438, 452, 453, 454, 455, 456, 464, 469, 479, 602
3. occupation levels over contexts 390/394/395	3.1	316, 317, 376, 399, 480, 481, 486, 488, 494, 495, 496, 600
	3.2	323, 324, 325, 327, 328, 333, 334, 335, 356, 400, 401, 409, 410, 411, 412, 424, 428, 466, 482, 489, 493, 497, 604
	3.3	342, 343, 349, 432, 433, 465, 490, 483, 499, 601, 604
	3.4	351, 352, 444, 447, 448, 449, 470, 484, 485, 491, 492, 603
4. pit fill	4.1	306, 315, 318, 319, 320, 321, 326, 329, 330, 331, 332, 336, 337, 341, 345, 346, 347, 348, 350, 353, 357, 358, 359, 369, 370, 371, 372, 373, 374, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 391, (392), 396, 402, 405, 406, 407, 408, 413, 414, 415, 417, 418, 419, 420, 425, 426, 427, 428, 441, 442, 443, 450, 459, 461, 466, 468, 472, 473, 474, 478, 487
5. basal levels and pits	5.1	(368), 390, (393), (394), (395), 397/398, 403, 404, 416, (460), 471, 439, 475, 476

The substantial number of AVK pottery finds from Trench A called for the examination of the stratigraphic position of these finds too. Again, we created a simplified stratigraphic model based on the 'contexts' and matrix of this trench. Four main levels and thirteen sub-levels were distinguished, as shown in *Table 27.4.*

Table 27.4. Excavation matrix with the 'contexts' of Ecsegfalva 23, Trench A

Layer sequence	Sub-levels	Ecsegfalva 23, Trench A, 'contexts'
1. AVK level	1.1	100
	1.2	101, 102
2. Körös level	2.1	103, 123, 132, 140
	2.2	104, 105
	2.3	106
3. AVK burial	3.1	107
2. Körös level	2.4	108
4. pit fill	4.1	109, 110, 112, 120, 124, 126, 133
	4.2	121
	4.3	111, 113, 114, 122, 127, 134, 141
	4.4	135
	4.5	125, (128), 129, 130, (131), 136, 137, (138), 139, 142
	4.6	143, 144, 145, 146

Finds of the Körös culture

Vessel fragment types

Similarly to the pottery from other Körös sites, the Early Neolithic vessels from Ecsegfalva were predominantly tempered with chaff. Sand was also used as a tempering agent in addition to chaff in the case of thin-walled fine wares, as was crushed pottery in a few cases. Most vessels are light brown or various shades of grey. A few ochre and orange coloured fragments also occur.

Body sherds

Body sherds account for the overwhelming majority of the almost twelve thousand joined pottery fragments. Undecorated body sherds offer little additional information. The decorated pottery sherds are described below in detail.

Rim forms

Rounded rims
Several vessel types have rounded rims *(Fig. 27.1. 1–2)*. These include bowls *(Fig. 27.8. 1–4, Fig. 27.9. 1, Fig. 27.10. 1–6, Fig. 27.11. 4–6, Fig. 27.13. 1–2, Fig. 27.14. 1–3, Fig. 27.15. 1–7, Fig. 27.16. 5)*, vessels with an S profile *(Fig. 27.19. 4)*, cups *(Fig. 27.20. 1–2)*, globular vessels with cylindrical neck *(Fig. 27.22. 1–2)*, flattened globular vessels *(Fig. 27.24. 3)*, storage jars *(Fig. 27.25. 2, Fig. 27.26. 1, 3)*, and pannier vessels *(Fig. 27.27. 1–4)*. One variant of rounded rims is thinned *(Fig. 27.1. 3)*, especially on bowls.

Flat rims
Angular, flat rims are quite rare *(Fig. 27.1. 5–6)*; most are usually finely smoothed and rounded *(Fig. 27.1. 4)*. This rim type can be noted on bowls *(Fig. 27.10. 8, Fig. 27.16. 4)*, vessels with an S profile *(Fig. 27.19. 3)*, and globular vessels with a short neck *(Fig. 27.22. 5)*, as well as on pannier vessels *(Fig. 27.27. 5)*.

Rims decorated with impressions
Vessel rims are often decorated using various techniques. The most common among these is ornamentation with finger impressions. This rim decoration can be seen on globular vessels with short, funnel-shaped *(Fig. 27.2. 1)*, cylindrical *(Fig. 27.2. 2)* or outcurving neck *(Fig. 27.2. 3)*, although it can occasionally be noted on conical bowls too *(Fig. 27.2. 5, Fig. 27.12. 1, 3–4)*. Vessel rims are occasionally also decorated with nail impressions *(Fig. 27.2. 4)*. Impressions smaller than a fingertip were made with a twig, a very rare practice *(Fig. 27.21. 2)*.

Splayed or lipped rims ('Lippenrand')
Slightly everted, thickened rims are predominantly found on biconical vessels *(Fig. 27.17. 1, 3–7)*. Good parallels to these rim fragments can be quoted from late Körös (Protovinča) assemblages, such as Öcsöd-Kiritó-nyugati part (Raczky 1988, fig. 8. 1–4). One variant of this rim form is the slightly thickened type on a short-necked, globular vessel *(Fig. 27.2. 6)*.

Basal forms

The classification of basal forms is rather difficult owing to the many variants of thickened and pedestalled types. In fact, each piece is different, with size and proportion differing from piece to piece. Many basal forms represent a transition between various types and their variants.

Thickened bases[7]
Thickened bases have a less pronounced variant with a flat *(Fig. 27.3. 3)* or concave surface *(Fig. 27.3. 1–2)*. Bases of this type can be noted on globular vessels *(Fig. 27.23. 2)* and bowls *(Fig. 27.8. 4, Fig. 27.14. 1, 3)*. One variant is concave and has a fine curve between the vessel body and the base and the vessel creates the impression of a ceramic object with flattened base *(Fig. 27.3. 1–2)*. A somewhat higher thickened base is more common *(Fig. 27.3. 4–6)*, especially among globular vessels *(Fig. 27.23. 3–4, Fig. 27.24. 1)* and storage jars *(Fig. 27.26. 6–7)*.

Pedestals
Both solid and hollow variants of pedestals occur among the finds. Pedestals were usually fitted to globular vessels and various variants of deep bowls. Kutzián described these vessels as goblets (Kutzián 1947, 5). The Ecsegfalva assemblage is dominated by low pedestals, whose height is smaller than one-half of the diameter. Solid pedestals are rather rare *(Fig. 27.3. 7)*, and variants with slightly concave base *(Fig. 27.3. 8–9)* form a transition to hollow pedestals. The most frequent hollow pedestals are conical in form *(Fig. 27.4. 1–6)*. Cylindrical ring pedestals with straight or almost straight walls are rare *(Fig. 27.4. 7)*. The finds also include a pedestal fragment with a small knob in the centre of the base *(Fig. 27.4. 8)*. One good parallel to this piece comes from Tiszaug-Tópart (Kutzián 1944, 69, pl. IX. 14a–b). Higher pedestals are rare and of the hollow type *(Fig. 27.5. 1–3)*.

Flat bases
Straight, flat bases are quite rare in the Early Neolithic ceramic assemblage from Ecsegfalva *(Fig. 27.5. 4–6)*. One of the restored biconical bowls has a base of this type *(Fig. 27.14. 2)*, as does a restored mug *(Fig. 27.21. 1)*. This type of base predominates in Middle Neolithic pottery assemblages, occurring also among the AVK finds from Ecsegfalva *(Fig. 27.61. 1, Fig. 27.62. 1–4)*. However, Middle Neolithic bases are more pronounced than those of the Körös culture.

Vessels standing on four feet
The use of vessels of this type is indicated by several basal fragments with one or more low feet and a part of the base *(Fig. 27.5. 7–8, Fig. 27.6. 1–6)*. The feet are oval *(Fig. 27.5. 7–8, Fig. 27.6. 5)* or elongated oval in section *(Fig. 27.6. 6)* and have a cylindrical or slightly conical form. Large, thick-walled vessels too have a variant with feet *(Fig. 27.6. 4)*, although the exact vessel form could not be reconstructed from the surviving vessel fragments. One of the reconstructed vessels is a funnel-necked, strongly flattened globular vessel with a fragmentary base, on which the stubs indicate that it was set on four small, oval feet. In addition to its unusual form, this vessel has a stroke-burnished decoration *(Fig. 27.24. 2a–c, Fig. 27.49. 2a–d)*.

The overwhelming majority of the four footed vessels of the Körös culture can be regarded as variants of different bowl types. Their form shows a great diversity, ranging from low, globular bowls, such as the ones found at Endrőd 39-Szujókereszt (Makkay 1987, 20, Abb. 2. 5), Endrőd 119-Öregszőlők (Makkay 1992, pl. 9. 1–4, 6–8, pl. 10. 1–3), Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, pl. XXXII. 5), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXII. 7) and Tiszaug-Tópart (Kutzián 1944, pl. V. 7), to conical ones (e.g. Endrőd 119-Öregszőlők: Makkay 1992, pl. 9. 5). A variant of the latter with a sharp carination is known from the same site (Makkay 1992, pl. 1. 6). Semi-spherical bowls set on four feet have been reported from Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, pl. XXXIII. 8), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXIII. 9), Endrőd 39-Szujókereszt-Trench 1 (Makkay 1987, 20, Abb. 2. 2) and Endrőd 119-Öregszőlők (Makkay 1992, pl. 12. 2–4, 6). Truncated globular bowls and their fragments have been found at Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXIII. 6), Endrőd 39-Szujókereszt (Makkay 1987, 20, Abb. 2. 6), Endrőd 119-Öregszőlők (Makkay 1992, pl. 13, 1–6, 8, pl. 14. 1–2) and Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXIII. 11, pl. XXXIV. 1–2). Deep bowls with a cylindrical upper part were recovered at Endrőd 39-Szujókereszt (Makkay 1987, 20, Abb. 2. 1, 7, 10) and Endrőd 119-Öregszőlők (Makkay 1992, pl. 13. 7, pl. 14. 4, pl. 17. 1). Truncated globular bowls with everted rim were found at Endrőd 39-Szujókereszt (Makkay 1987, 20, Abb. 2. 3–4), Endrőd 119-Öregszőlők (Makkay 1992, pl. 11. 5–8, pl. 14. 3, 5–8), Hódmezővásárhely-Kopáncs-Kovács-tanya (Kutzián 1944, pl. XXXIV. 4), and Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXIV. 3, 6), and it seems likely that two bowl fragments found at Tiszaug-Tópart too come from a vessel of this type (Kutzián 1944, pl. V. 1–2). Globular and flattened globular vessel with a funnel or cylindrical neck are known from Endrőd 119-Öregszőlők (Makkay 1992, pl. 12. 5, 7), Hódmezővásárhely-Kopáncs-Kovács-tanya (Kutzián 1944, pl. XX. 4) and Szolnok-Szanda (Kalicz and Raczky 1980–81, Taf. 5. 2, Taf. 6. 3a–3b). Other vessels in this category with a broken neck can be quoted from Endrőd 119-Öregszőlők (Makkay 1992, pl. 12. 8) and Tiszaug-Tópart (Kutzián 1944, pl. V. 10). A one-handled cup set on feet was found at Szolnok-Szanda (Kalicz and Raczky 1980–81, Taf. 12. 1). Pannier vessels set on four feet are known from Endrőd 119-Öregszőlők (Makkay 1992, pl. 24. 1, 4), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXV. 4) and Szolnok-Szanda (Kalicz and Raczky 1980–81, Taf. 5. 1a–b). Fragments of four-footed vessels have been reported from Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXIV. 7), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXIV. 8–9), Tiszajenő-Szárazérpart (Raczky 1976, fig. 7. 8–9) and Tiszaug-Tópart (Kutzián 1944, pl. V. 4–6). A unique, five-footed fragment was found at Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXIV. 10).

Handles and handle fragments

The Ecsegfalva pottery assemblage is dominated by low handles *(Fig. 27.7. 1–7)*. Handles of this type are predominantly set on the carination of globular vessels. One handle is decorated with a groove created by a finger impression *(Fig. 27.7. 5)*. Smaller, knob-like handles are applied to the shoulder of globular vessels *(Fig. 27.22. 1)*. Cups are usually fitted with wide handles with a round or oval section *(Fig. 27.20. 5–8)*. These will be discussed at greater length below. A string-hole handle *(Fig. 27.7. 8)* is a unique piece, as is an elbow handle *(Fig. 27.7. 9)* recalling Middle Neolithic handle forms. The fabric and firing technique of the latter two finds, however, assign them to the Early Neolithic.

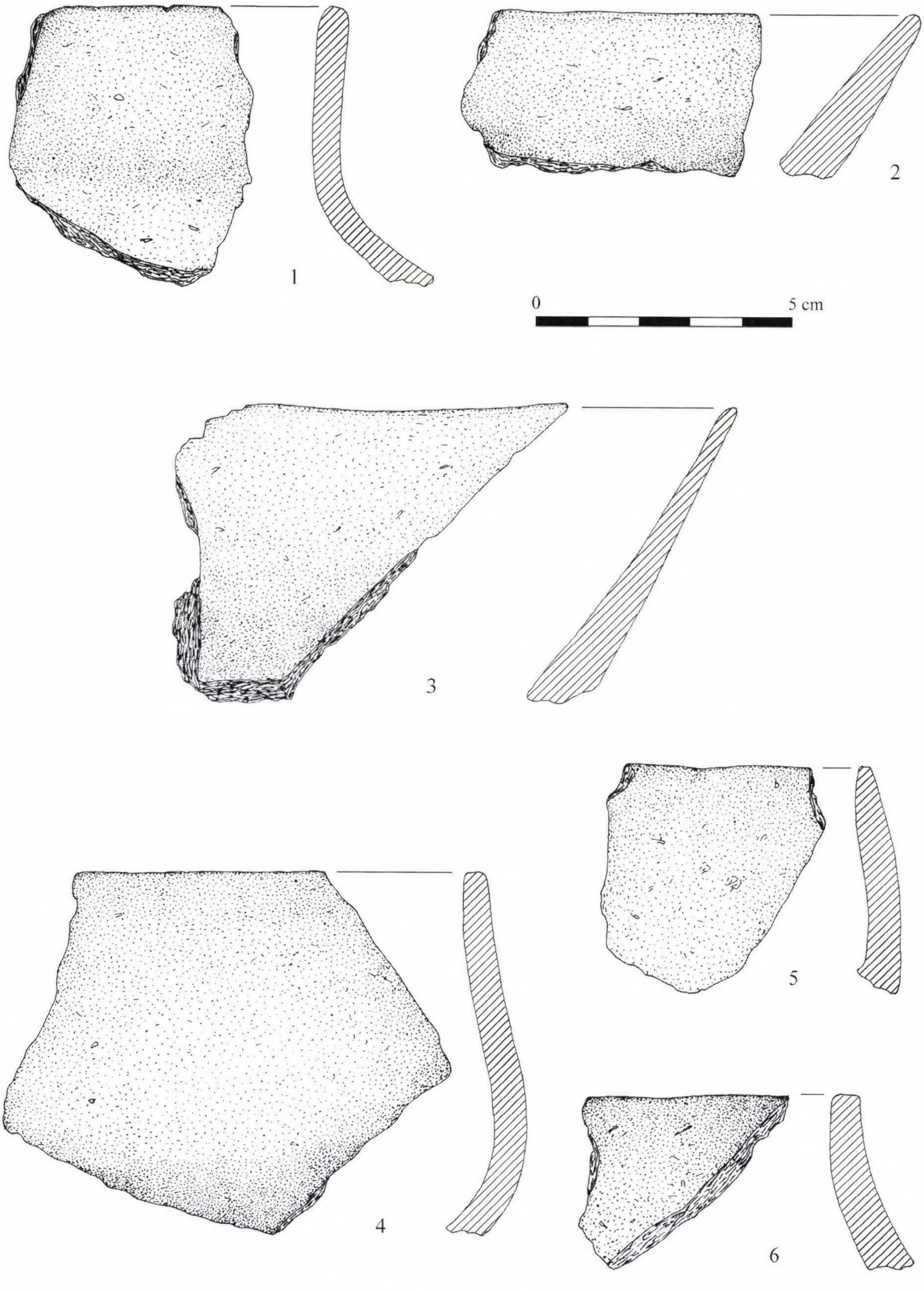


Fig. 27.1. Rounded and flat rims

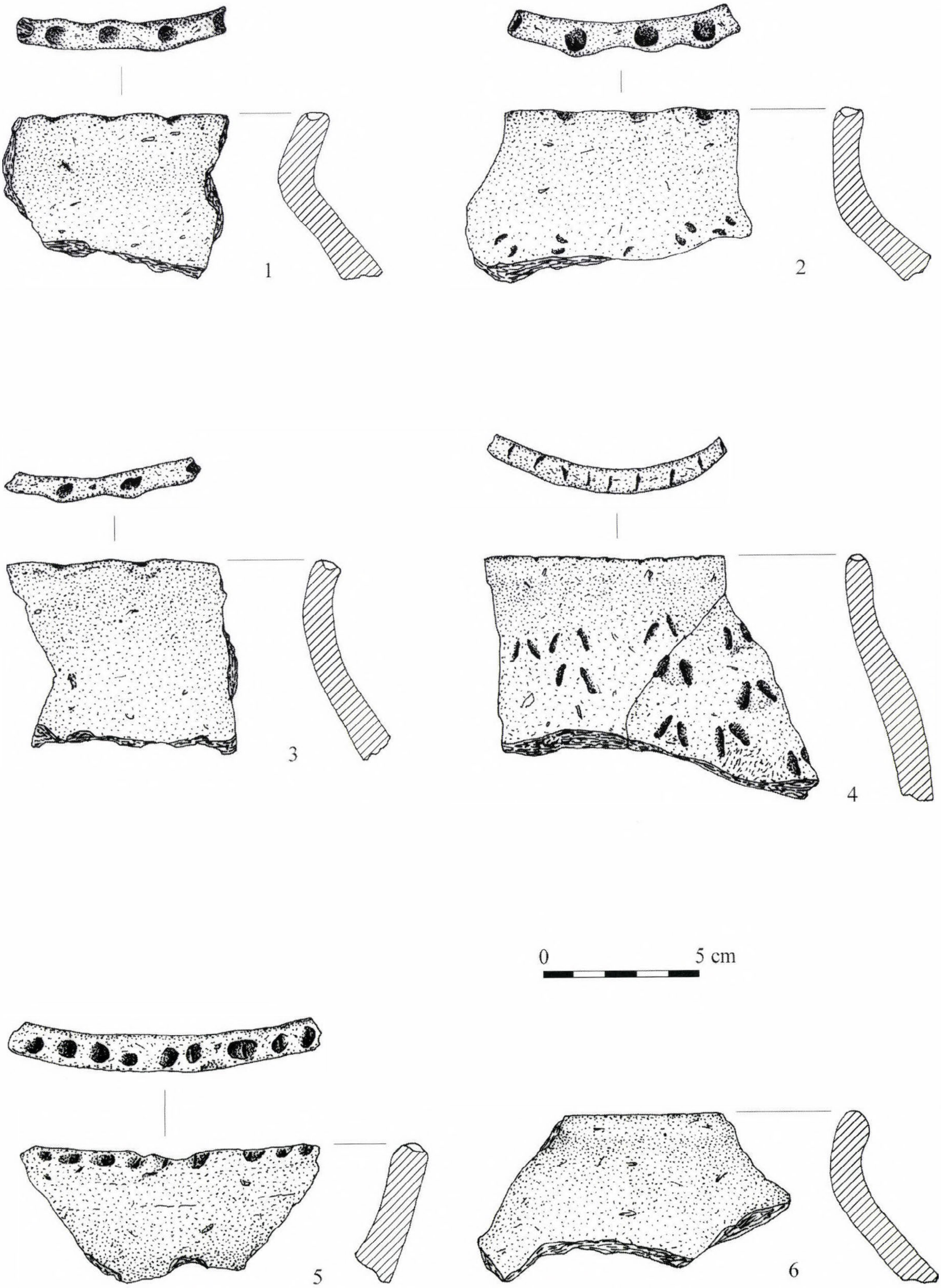


Fig. 27.2. Rims decorated with impressions

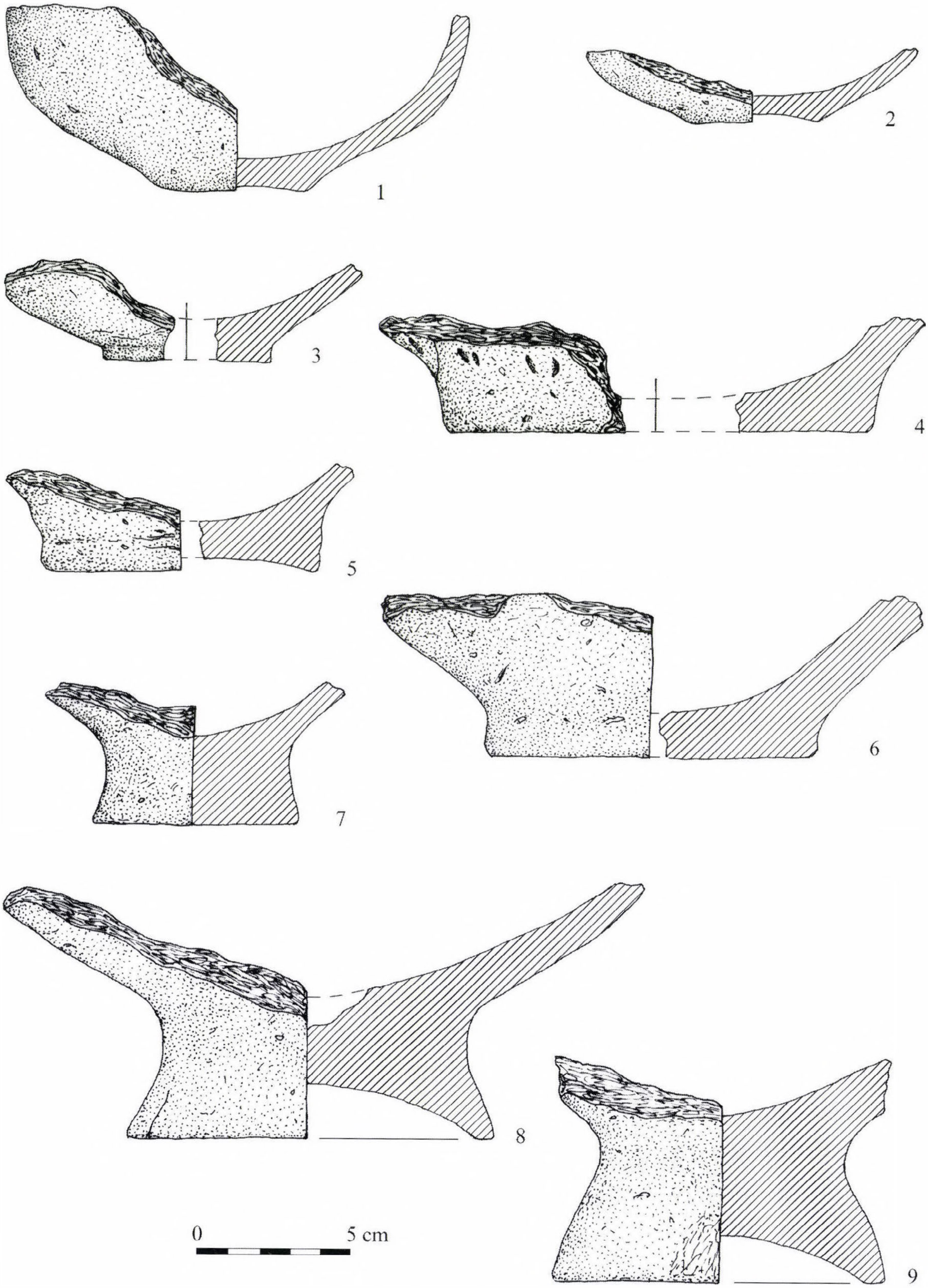


Fig. 27.3. Thickened bases and pedestals

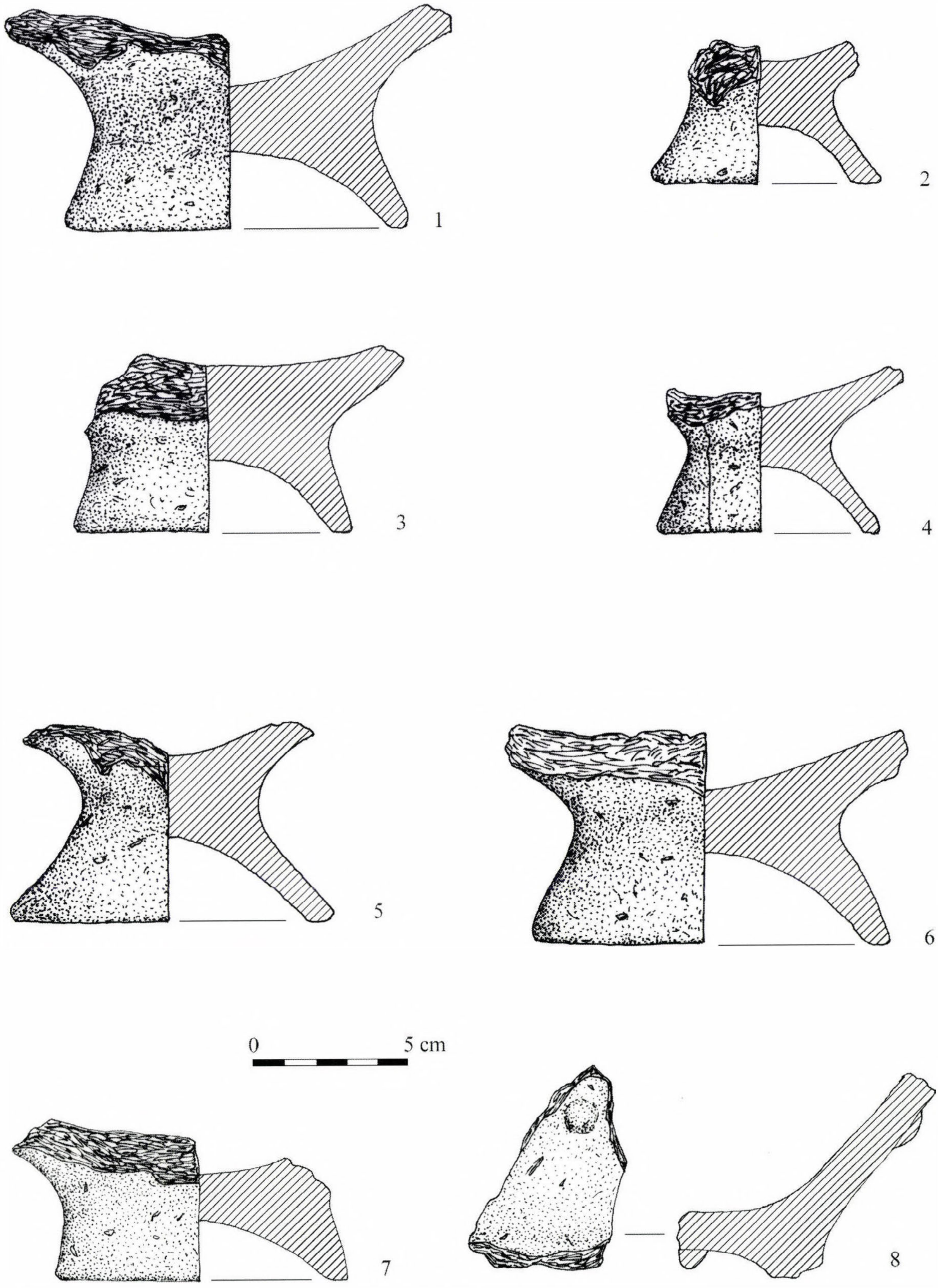


Fig. 27.4. Pedestals

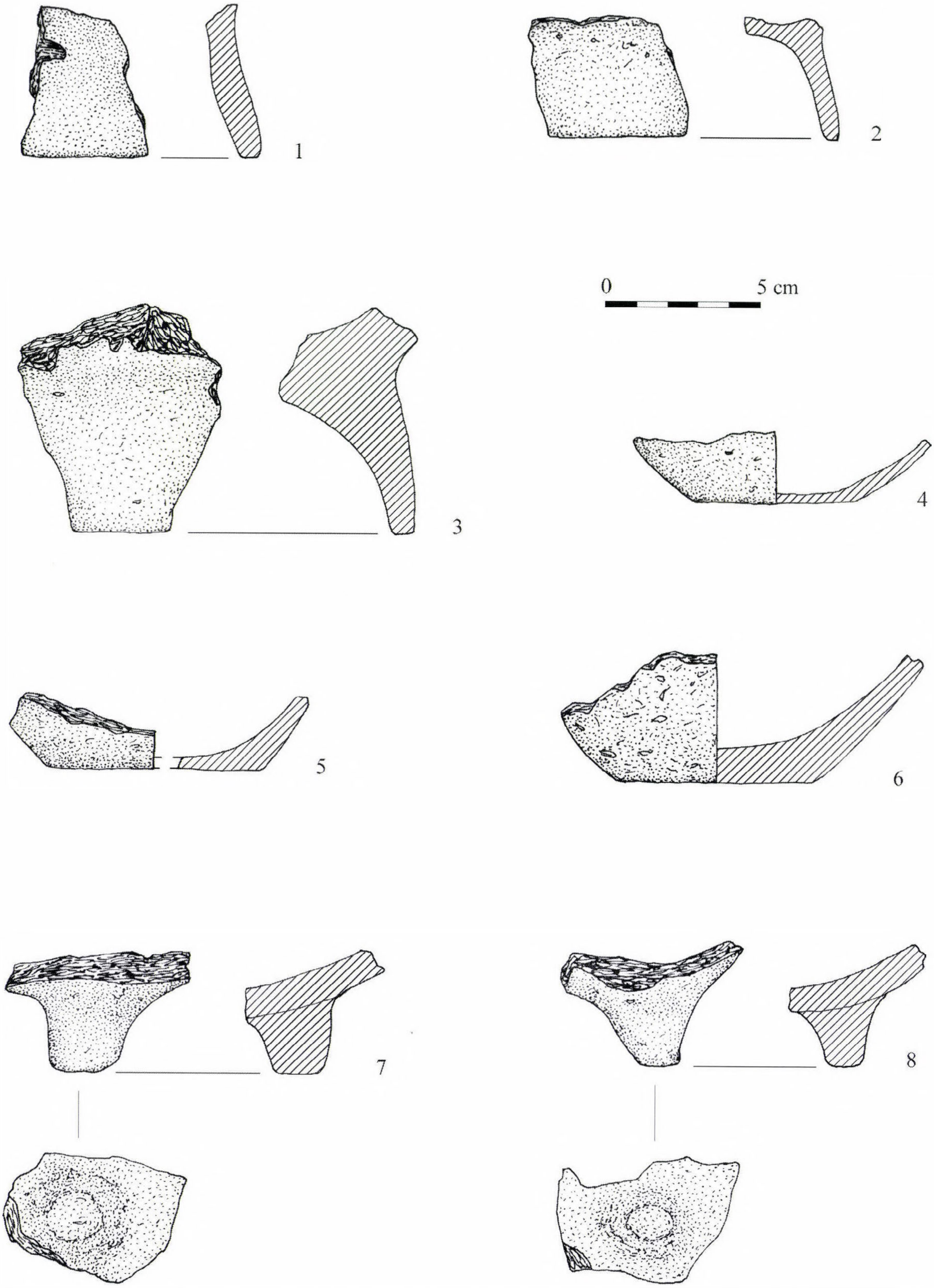


Fig. 27.5. Higher pedestals, flat bases and basal fragments of vessels standing on four feet

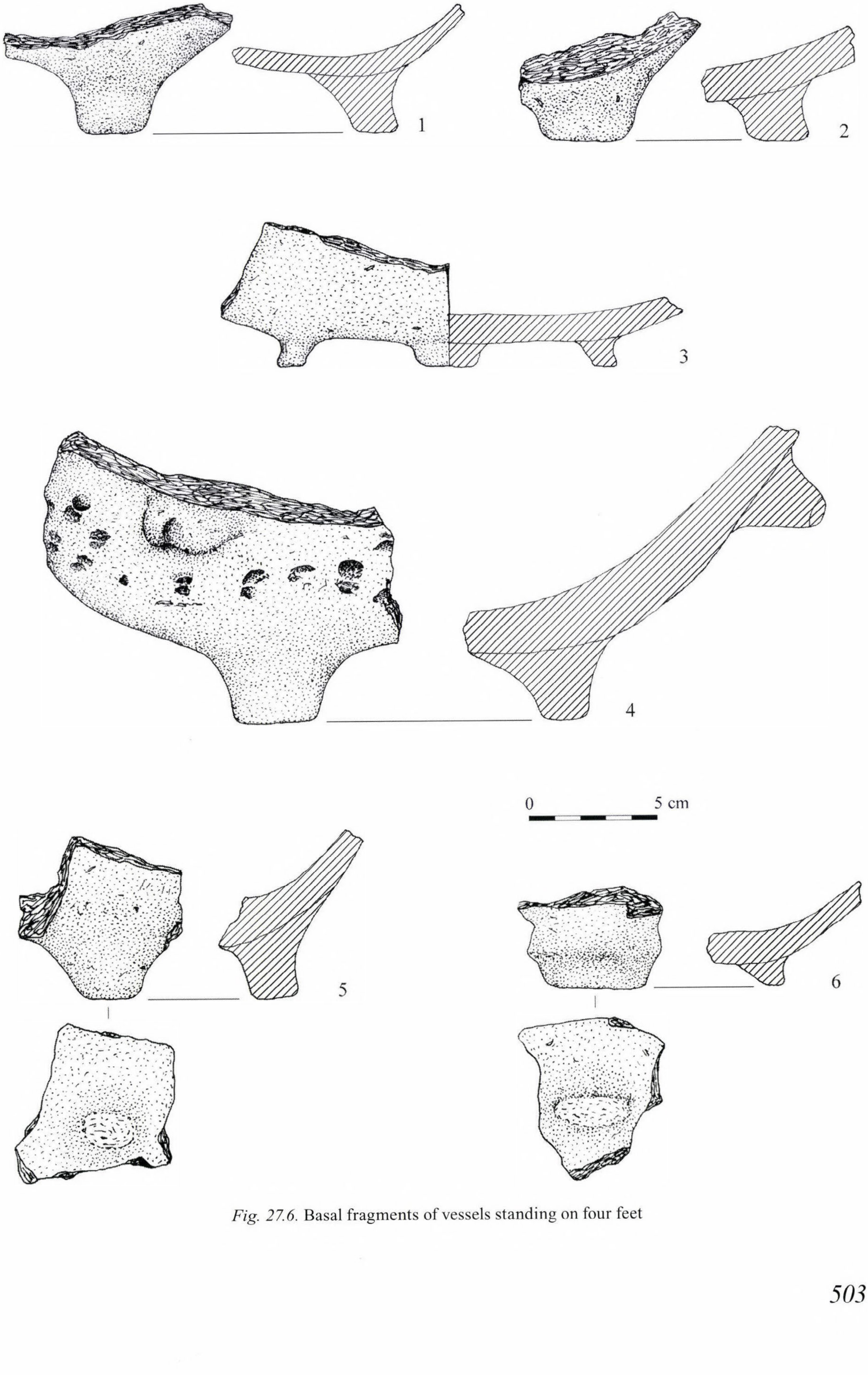


Fig. 27.6. Basal fragments of vessels standing on four feet

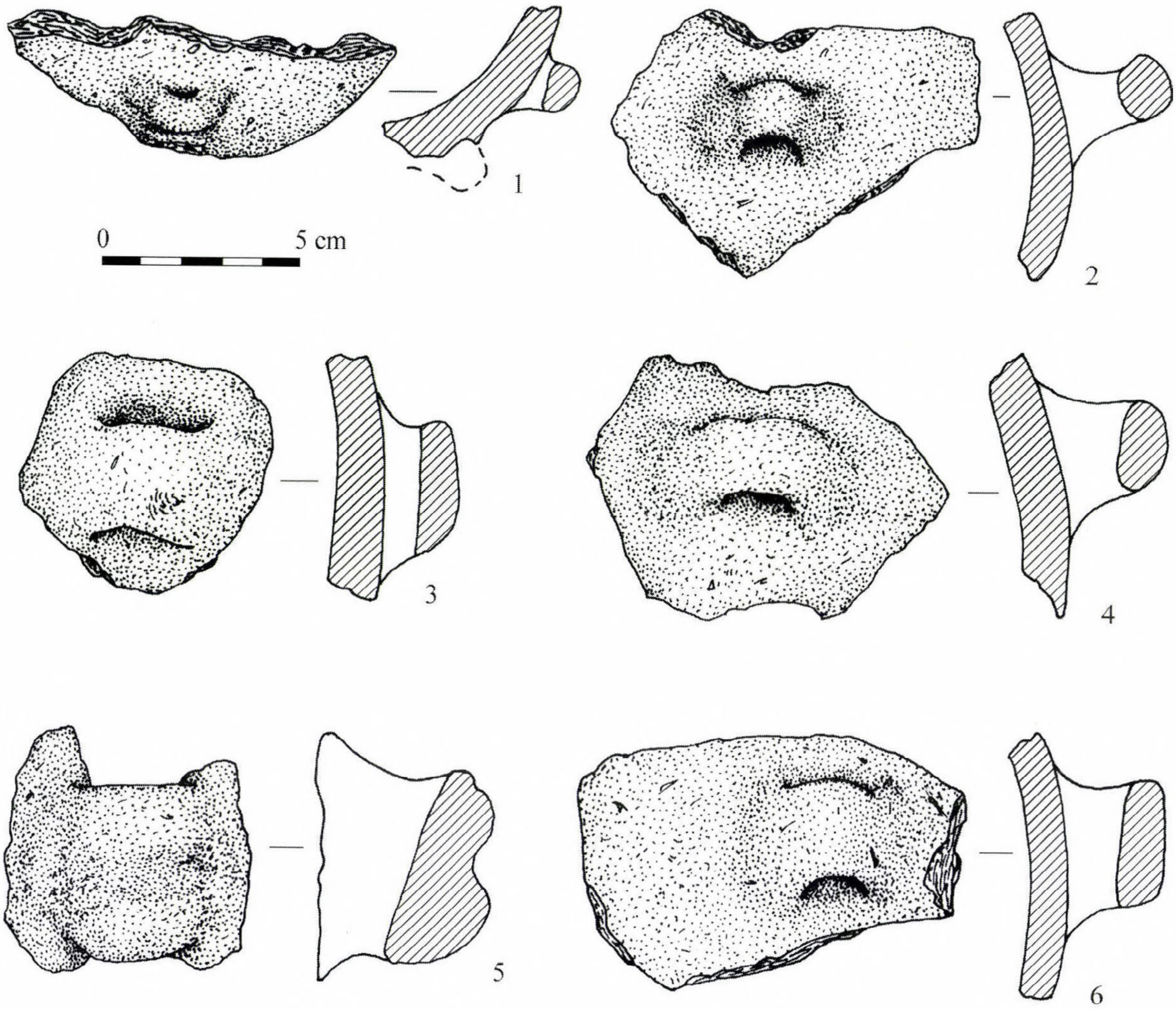


Fig. 27.7. Vessel handles

Vessel forms

Bowls

The ceramic assemblage from Ecsegfalva is dominated by bowls, whose rim and base forms show an astonishing variety. The main variants, distinguished according to formal criteria, are discussed separately.

Globular bowls

Fragments of globular bowls occur in great number *(Fig. 27.10. 1–8, Fig. 27.11. 1–3)*. Most have a rounded, sometimes slightly thinning rim *(Fig. 27.10. 5–6)*. Many are decorated with oval knobs *(Fig. 27.10. 6, 8)*. The three small globular bowls assembled from their fragments have a rim diameter of 8–10 cm *(Fig. 27.8. 1–3)*; two have a thickened base *(Fig. 27.8. 1, 3)*, the third has a flat base *(Fig. 27.8. 2)*.

Conical bowls

Three small, conical bowls could be assembled from their fragments during the restoration of the pottery finds *(Fig. 27.8. 4, Fig. 27.9. 1–2)*. Fragments from both smaller *(Fig. 27.11. 4–6)* and larger bowls *(Fig. 27.12. 1, 3–4)* could be assigned to this type. Smaller conical bowls have a rounded rim *(Fig. 27.8. 4, Fig. 27.9. 1–2, Fig. 27.11. 4–6)*, similarly to globular bowls, while larger ones have a rim decorated with finger impressions *(Fig. 27.12. 1, 3–4)*. One of the larger bowls is decorated with barbotine *(Fig. 27.12. 3)*.

Bowls with cylindrical upper part

One widespread Körös bowl type has a cylindrical or slightly indrawn upper part. Two bowls of this type could be assembled from their fragments *(Fig. 27.13. 1–2, Fig. 27.30. 2–3)*. The pottery finds include several fragments from such bowls *(Fig. 27.15. 1–3)*. Most have a rounded rim. The lower part of the vessel is conical and has a thickened, slightly concave base. Their carination is rounded, without a sharp break between the cylindrical upper and the conical lower part. Oval knobs are sometimes set on the carination *(Fig. 27.13. 1, Fig. 27.30. 2)*.

Carinated bowls

The ceramic finds include the fragments of three restorable biconical vessels. Two fragments come from the vessels on which the carination lay about one-third down the vessel body and the vessel's greater part lay under the carination *(Fig. 27.14. 1–2, Fig. 27.30. 4–5)*. This proportion is typical for the biconical vessels of the Körös culture. Close parallels to the Ecsegfalva bowls can be quoted from Öcsöd-Kiritó-nyugati part (Raczky 1988, fig. 5. 3, 6, fig. 6. 8). The carination on the third bowl lies about one-half down the vessel body *(Fig. 27.14. 3, Fig. 27.30. 6)*. All three bowls have rounded rims. A rounded rim can be noted on several other biconical bowl fragments too *(Fig. 27.15. 5–7, Fig. 27.16. 1, 5–6)*. The other characteristic rim form of biconical bowls is a thickened rim above the curved or slightly angular neck *(Fig. 27.17. 1–7)*. A number of other rim sherds *(Fig. 27.18. 1)* and body fragments *(Fig. 27.16. 2–3, Fig. 27.18. 2–3, 5)* come from biconical bowls. Another variant has the upper part widening above the carination *(Fig. 27.15. 4, Fig. 27.18. 4, 7–8)* or a curving upper part *(Fig. 27.18. 6)*. Carinated pieces also occur among the large bowls *(Fig. 27.12. 2)*. Two of the restored carinated bowls have a thickened base *(Fig. 27.14. 1, 3, Fig. 27.30. 4, 6)*, the third has a straight, flat base *(Fig. 27.14. 2, Fig. 27.30. 5)*. An oval knob is set on the carination of one biconical bowl; three such evenly spaced knobs had originally decorated the vessel *(Fig. 27.14. 2, Fig. 27.30. 5)*. Knobs set on the carination often adorn carinated vessels *(Fig. 27.16. 2–6, Fig. 27.17. 1–2, Fig. 27.18. 7)* occurring in assemblages dated to the late or latest Körös phase, such as the ones from Bucsa 23-Töviskes-hát (Ecsedy *et al.* 1982, 34, pl. 5. 5), Dévaványa 1-Kér-sziget-Katonaföldek (Ecsedy *et al.* 1982, 35, pl. 5. 13), Dévaványa 26-Réhely-dűlő (Ecsedy *et al.* 1982, 42–43, pl. 5. 7), Dévaványa-Atyaszeg (Oravecz 1995, 63, Abb. 1. 1–4, 6–7) and Endrőd 119-Öregszőlők (Makkay 1992, 151, pl. 1. 5).

Bowls with an S profile

Deep bowls with a gentle S profile also occur among the pottery finds. They have a thinning or flat rim and a globular body *(Fig. 27.19. 1–5)*. The single specimen which could be assembled from its fragments has a concave base *(Fig. 27.19. 1, Fig. 27.31. 1)*.

Flowerpot-shaped vessel

The finds include a flowerpot-shaped vessel with a slightly angular profile and a rounded rim. Its upper part is slightly curved, the lower part is conical, and the base is thickened *(Fig. 27.9. 3, Fig. 27.30. 1)*.

Cups

Two small cups could be assembled from their fragments. One is conical *(Fig. 27.20. 1, Fig. 27.31. 2)*, the other has a slightly elongated, semi-spherical form *(Fig. 27.20. 2, Fig. 27.31. 3)*; both have a thickened base. A similar conical cup fitted with a handle is known from Endrőd 35-Öregszőlők II (Makkay 1980, 212, Taf. 121. 3). Even though there was no stub indicating a possible handle on the pieces from Ecsegfalva, the possibility that they had a handle cannot be excluded. An elongated semi-spherical cup with a curved profile has been published from Endrőd 119-Öregszőlők (Makkay 1992, pl. 26. 8), and a similar cup was recovered from a burial at Szakmár-Kisülés, a Körös site on the left bank of the Danube (Kutzián 1978, 16, Taf. 2. 2).

Handled cups

Even though the pottery finds did not include fragments from which a one-handled cup could be restored, the form and size of a few basal fragments with a handle stub *(Fig. 27.20. 3–4)* and handle fragments *(Fig. 27.20. 5–8)* suggest that these came from one-handled cups.

The pottery assemblages from several Körös sites contained the culture's typical one-handled cups. Finds of this type have been reported from Endrőd 35-Öregszőlők II (Makkay 1980, Taf. 121. 2), Endrőd 39-Szujókereszt (Makkay 1980, Taf. 122. 1, 3, 5–6), Endrőd 119-Öregszőlők (Makkay 1992, pl. 27. 4–7), Szajol-Felsőföld (Raczky 1988, fig. 3. 1–2), Szarvas 8-Szappanos (Makkay 1980, Taf. 120. 2, 4), Szarvas 23-Egyházföld (Makkay 1980, Taf. 121. 4–6), Szentes-Ilonapart (Makkay 1980, Taf. 119. 1a–c), Szentes-Boros Sámuel utca (Makkay 1980, Taf. 120. 1a–c) and Szolnok-Szanda (Kalicz and Raczky 1980–81, Taf. 12. 1). Most of these handles are undecorated and round or oval in section. The decorated pieces have small knobs (Makkay 1980, Taf. 119. 1a–c) or pairs of knobs (Makkay 1980, Taf. 120. 1a–c) set on them, or are adorned with incised lines (Raczky 1988, fig. 3. 1). One-handled cups and their fragments were first discussed in detail by Makkay (1980, 210–13). The specimens from the sites in the Szarvas area (Szarvas 23-Egyházföld, Szarvas 8-Szappanos) and the Endrőd area (Endrőd 35-Öregszőlők II, Endrőd 39-Szujókereszt) represented the same type as regards their form. Makkay was uncertain as to which Körös phase these cups should be assigned. The early date for the Szarvas 23-Egyházföld site suggested that handled cups were used from the earliest Körös phase and survived throughout the Körös sequence (Makkay 1980, 213). He argued for the early date of this cup type, citing their association with white on red painted pottery at Szarvas 23-Egyházföld and Endrőd 119-Öregszőlők (Makkay 1996, 46). Kalicz and Raczky dated the appearance of this vessel type to the Karanovo II horizon (Kalicz and Raczky 1980–81, 20–21; Raczky 1988, 20). Ferenc Horváth pointed out that the presence of these cups in the Middle Tisza region and their absence from the sites in the Maros region was one of the few regional differences between the Körös assemblages from these two regions (Horváth 1996, 127–28).

Mug

A typical mug of the Körös culture could be assembled from the pottery fragments. It has a cylindrical neck, a biconical body and a gentle carination *(Fig. 27.21. 1, Fig. 27.31. 4)*. The vessel part below the carination is larger than the one above it, and both are slightly curved. The vessel base is flat. A similar mug is known from Öcsöd-Kiritó-nyugati part (Raczky 1988, fig. 5. 8).

Globular vessels

Fragments from globular vessels make up an important portion of the ceramic assemblage. In spite of the many fragments, only one vessel could be assembled *(Fig. 27.21. 2, Fig. 27.31. 5)*. This vessel type is usually described as a cooking pot, referring to its probable function (Kutzián 1944, 55–58; Raczky 1976, 172, table 1, 173, table 2, fig. 4. 1–2, 5, fig. 5. 1, 6, fig. 6. 1, fig. 9. 1–8). Most have a rim decorated with finger impressions *(Fig. 27.21. 3–5, Fig. 27.22. 3–4, Fig. 27.23. 1)*, a few are decorated with twig impressions *(Fig. 27.21. 2)*. Some rims are rounded and thicken slightly *(Fig. 27.2. 6, Fig. 27.22. 7)*. Most of these vessels have a low, cylindrical neck *(Fig. 27.21. 4, Fig. 27.22. 1–2, 4)*. Some vessel necks are slightly indrawn *(Fig. 27.21. 2)*. A few vessels have an outcurving neck *(Fig. 27.21. 3, 5)* or a low, slightly cylindrical neck, whereby the vessel has a truncated globular form in profile *(Fig. 27.22. 5–6)*. Rim sherds from strongly rounded vessels can probably be assigned to this type *(Fig. 27.23. 1)*. Most globular vessels have a thickened base *(Fig. 27.23. 2–4, Fig. 27.24. 1)*. In some cases, a small handle is set on the shoulder *(Fig. 27.22. 1)*. Their ornamentation ranges from pinched decoration *(Fig. 27.21. 2, Fig. 27.23. 2–3)* and pinched spike patterns *(Fig. 27.21. 3)* to linear motifs *(Fig. 27.23. 1)*, applied barbotine *(Fig. 27.23. 4, Fig. 27.31. 6)* and knobs, the latter coming in impressed *(Fig. 27.21. 5, Fig. 27.22. 5, Fig. 27.23. 2)* and divided forms *(Fig. 27.22. 6)*. Pinched decoration and barbotine sometimes covers the entire surface of the pottery fragments *(Fig. 27.21. 2, Fig. 27.23. 4)*.

Flattened globular vessels

One rare vessel form has a funnel neck and a flattened globular body. Similarly to the other vessels, they are usually tempered with chaff, although sand and crushed pottery were also used as tempering agents. One vessel of this type could be assembled from its fragments *(Fig. 27.24. 2a–c, Fig. 27.49. 2a–d)*. Its wall is thinner than that of the average vessel. A horizontal handle is set at the junction of the funnel neck and globular body. The form of its base is uncertain; it would appear that the vessel was set on four small cylindrical feet. Traces of a stroke burnished pattern could be made out on the slightly worn surface *(Fig. 27.24. 2c, Fig. 27.49. 2c–d)*. Another vessel with a similar profile and a thinner than average wall is lightly burnished and decorated with a bipartite knob set on the carination *(Fig. 27.24. 3)*.

Storage jars

Storage jars with a short cylindrical or funnel-shaped neck and wide shoulders are widespread forms, occurring on all Körös sites. Most have a rounded rim and a globular or, more rarely, cylindrical body (Banner 1932, pl. III; Kutzián 1944, pl. XX. 1a–b). The cylindrical variant is absent from Ecsegfalva; in contrast, several fragments of the globular variant have been found *(Fig. 27.25. 2–3, Fig. 27.26. 1, 3–5)*. Unfortunately, the surviving pieces did not allow a reconstruction of the vessel, and thus the base of this type can only be tentatively identified with the large, thickened basal sherds *(Fig. 27.26. 6–7)*. Storage jars with a comparable base are known from Bukova-puszta[8] (Banner 1932, pl. XXV. 2–3; Kutzián 1944, pl. XXII. 4a–b), Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXI. 1–2, pl. XXII. 3, pl. XXIII. 1), Endrőd (Kutzián 1944, pl. XIV. 1), Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Banner 1932, pl. III; Kutzián 1944, pl. XX. 1a–b), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXI. 3–5, pl. XXII. 1–2) and Tiszaug-Tópart (Kutzián 1944, pl. IV. 1–2). The specimens from Ecsegfalva are decorated with applied barbotine, parallel incised lines, knobs and finger impressed ribs *(Fig. 27.25. 2–3, Fig. 27.26. 1–5, Fig. 27.32. 1–2)*. A body fragment made up of two joined sherds is decorated with dense mussel impressions and pairs of slightly wavy incised lines *(Fig. 27.25. 3, Fig. 27.32. 2)*. Several rim fragments indicate that a row of knobs often encircles the neck at the junction of the neck and the vessel body *(Fig. 27.26. 1–2)*. Another variant is represented by the fragments of a rounded, barrel shaped vessel, whose rim bears finger impression. The body is adorned with a combination of double knobs, a spike pattern and pairs of incised wavy lines. The form of its base is unknown *(Fig. 27.25. 1)*. Its size suggests that it was a storage jar, although its unusual form and the unknown type of base would allow the reconstruction of a deep bowl too.

Pannier vessels

This rather unusual vessel form was identified quite early in the research of the Körös culture (Kisléghi Nagy 1911, 154, 160, fig. F. 1a–b). The vessel has a cylindrical, outcurving or funnel-shaped neck, a globular body, a thickened base or, more rarely, four small feet. A pair of vertically perforated handles is set on the vessel's upper and lower part. The handles are not set opposite each other, but on the same side of the body. The pair on the upper part is usually set closer to each other, the one on the lower part is spaced slightly farther apart, but in line with each other. The position of the handles would have allowed the vessel to be carried on the back, an interpretation reflected in the name given to this vessel form.

The pottery finds from Ecsegfalva include a pannier vessel with thickened base which could be assembled from its fragments *(Fig. 27.27. 5, Fig. 27.32. 3a–b)*. The rim and shoulder fragment of a variant with an everted rim *(Fig. 27.27. 1)* and a funnel rim *(Fig. 27.27. 3)* fitted with an upper handle also came to light. It is uncertain whether a few other everted *(Fig. 27.27. 2)* and funnel-shaped *(Fig. 27.27. 4)* rim fragments can be assigned to a pannier vessel or a flattened spherical vessel type.

According to Kutzián, the vessels in this category were asymmetrical, with one side strongly rounded, the other almost flat, whereby they fitted comfortably on a human or pack animal's back (Kutzián 1944, 50). It must here be noted that roughly or entirely symmetrical pieces with strongly rounded sides are not infrequent either. The restored specimen from Ecsegfalva *(Fig. 27.27. 5, Fig. 27.32. 3a–b)* must have been rather uncomfortable if fastened to the back with the aid of leather straps or a rope.

Pannier vessels were rather widespread in the Körös culture. Good parallels can be quoted from many Körös sites in Hungary, including Endrőd 119-Öregszőlők (Makkay 1992, pl. 24. 1, 3–4), Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, pl. XXV. 5), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXV. 2–4), Kőtelek-Huszársarok, Pit 1 (Raczky 1983b, 166, 178, fig. 18. 1), Ókécske near Kecskemét (Kutzián 1944, pl. XIII. 15a–b), Sövényháza (Kutzián 1944, pl. I. 1, pl. XI. 1a–b), and Szolnok-Szanda (Kalicz and Raczky 1980–81, 16, Taf. 5. 1a–b). Vessels of this type have been reported from the Early Neolithic settlement at Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXV. 6, pl. XXVI. 2).

Altars

Two restorable altars were brought to light at Ecsegfalva. The smaller one has a globular bowl or cup shaped upper part and is set on four cylindrical feet; the feet are a direct continuation of the upper part *(Fig. 27.28. 5, Fig. 27.32. 5)*. The other altar stands on three feet, which are likewise a direct continuation of the globular bowl or cup-shaped upper part *(Fig. 27.28. 3, Fig 27.32. 4)*. The feet of the three-footed altar are wide, flat and ribbon-like. Some of the rim sherds in the ceramic assemblage may have come from the upper, globular bowl of altars *(Fig. 27.28. 1–2)*. A flat, wide fragment decorated with a grooved rib is perhaps a foot from a three-footed altar *(Fig. 27.28. 4)*. Another altar foot is decorated with incised lines on its outer part and sides *(Fig. 27.29. 1)*. A corner fragment with the stub of the foot from a rectangular altar was also recovered. The form of this fragment suggests that the upper globular part was set on a horizontal surface resting on the feet *(Fig. 27.29. 4)*. The form, colour and fabric of two other altar feet suggest that they came from the same altar *(Fig. 27.29. 2–3)*. The corner of the flat surface survived on one of these fragments *(Fig. 27.29. 3)*.

Altars, both broken and intact pieces, are regularly found on Körös sites in Hungary. One of the earliest specimens is a piece among the finds from the Szeged region (Pulszky 1882, pl. II. 2, Reizner 1899, 11, fig. 2): a four-footed altar fragment (Kutzián 1944, 5, pl. I. 4). Several variants can be distinguished among the small Körös altars. One of these variants has three or four feet which continue directly in the globular bowl or cup-shaped upper part. The other has a horizontal, flat section between the feet and the upper part. The latter type comes with both three and four feet; in the former case, the flat section is triangular, while in the latter it is obviously quadrangular. Good analogies to the three-footed variant continuing directly in the upper part can be quoted from Endrőd 119-Öregszőlők (Makkay 1992, pl. 32. 6) and Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXVI. 11). Four-footed altars with the feet directly under the upper bowl-shaped part have been reported from Bukova-puszta (Kutzián 1944, pl. XXXV. 5), Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXV. 7–8, 11), Krstur/Szerbkeresztúr (Kutzián 1944, pl. XXXV. 10) and Tiszaug-Tópart (Kutzián 1944, VI. 1). A fragment from Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Banner 1932, Taf. V. 16; Kutzián 1944, pl. XXXIV. 15) and two specimens from Tiszaug-Tópart (Kutzián 1944, pl. VI. 2, 5) can probably be assigned to this type. Three-footed altars with the feet supporting a flat, triangular platform have been brought to light at Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XXXVI. 10), Endrőd 119-Öregszőlők (Makkay 1992, pl. XXXII. 4) and Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXXVI. 1).

Another altar (or lamp) type is represented by the pieces whose lower part is modelled in the shape of a four-footed animal with a globular cup fitted to its back. This variant does not occur among the finds from the Ecsegfalva 23 site.

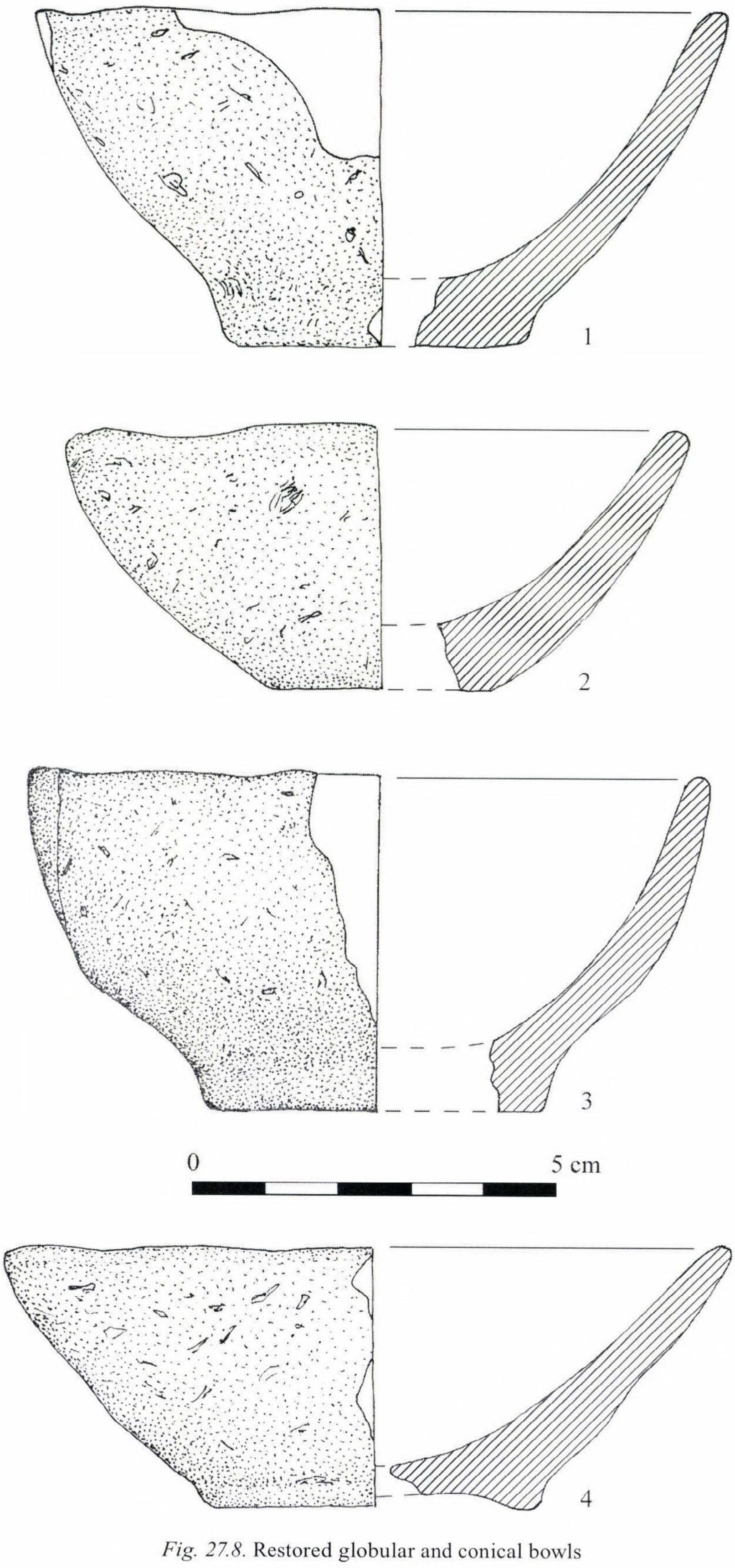


Fig. 27.8. Restored globular and conical bowls

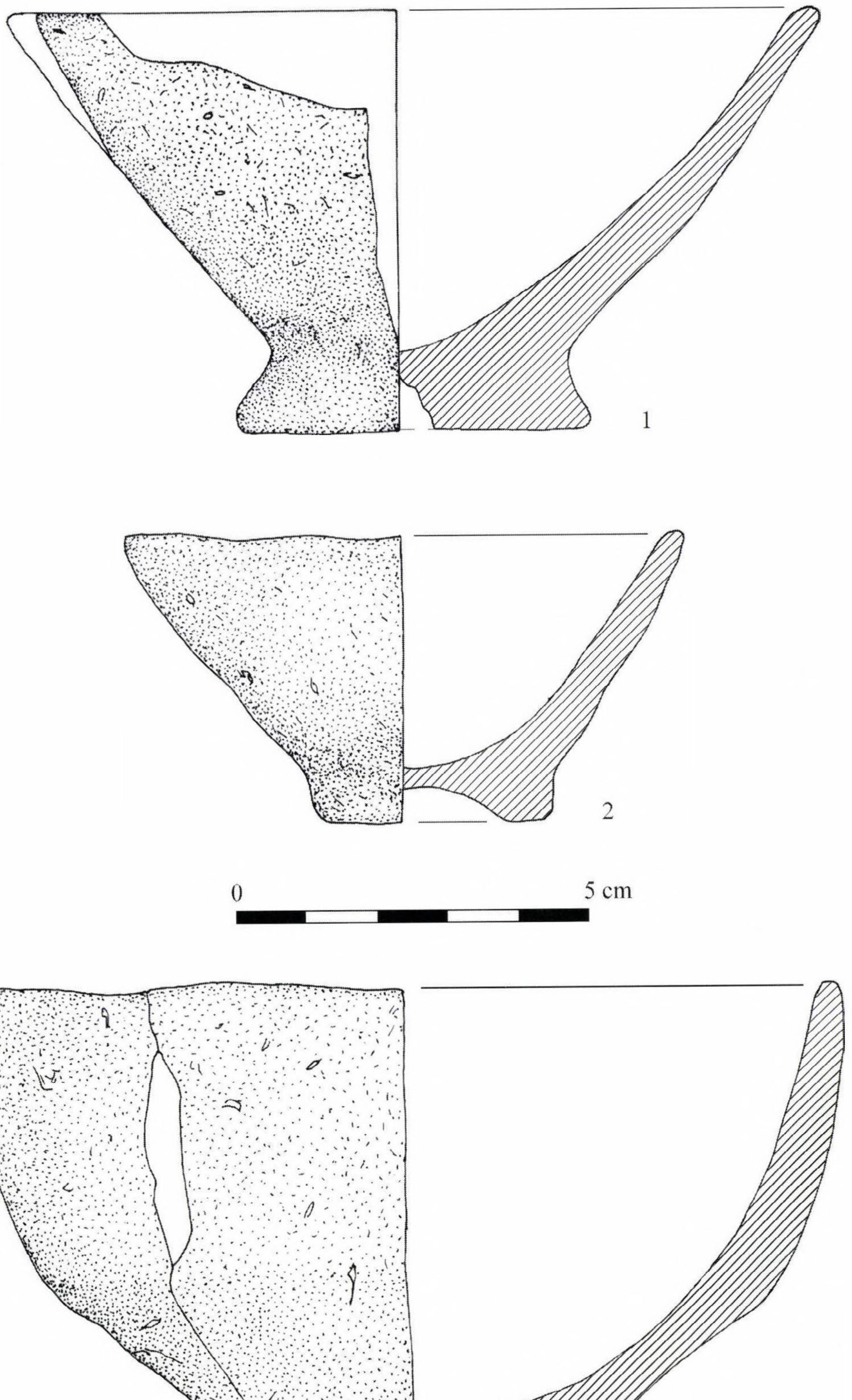


Fig. 27.9. Restored conical bowls and flowerpot-shaped vessel

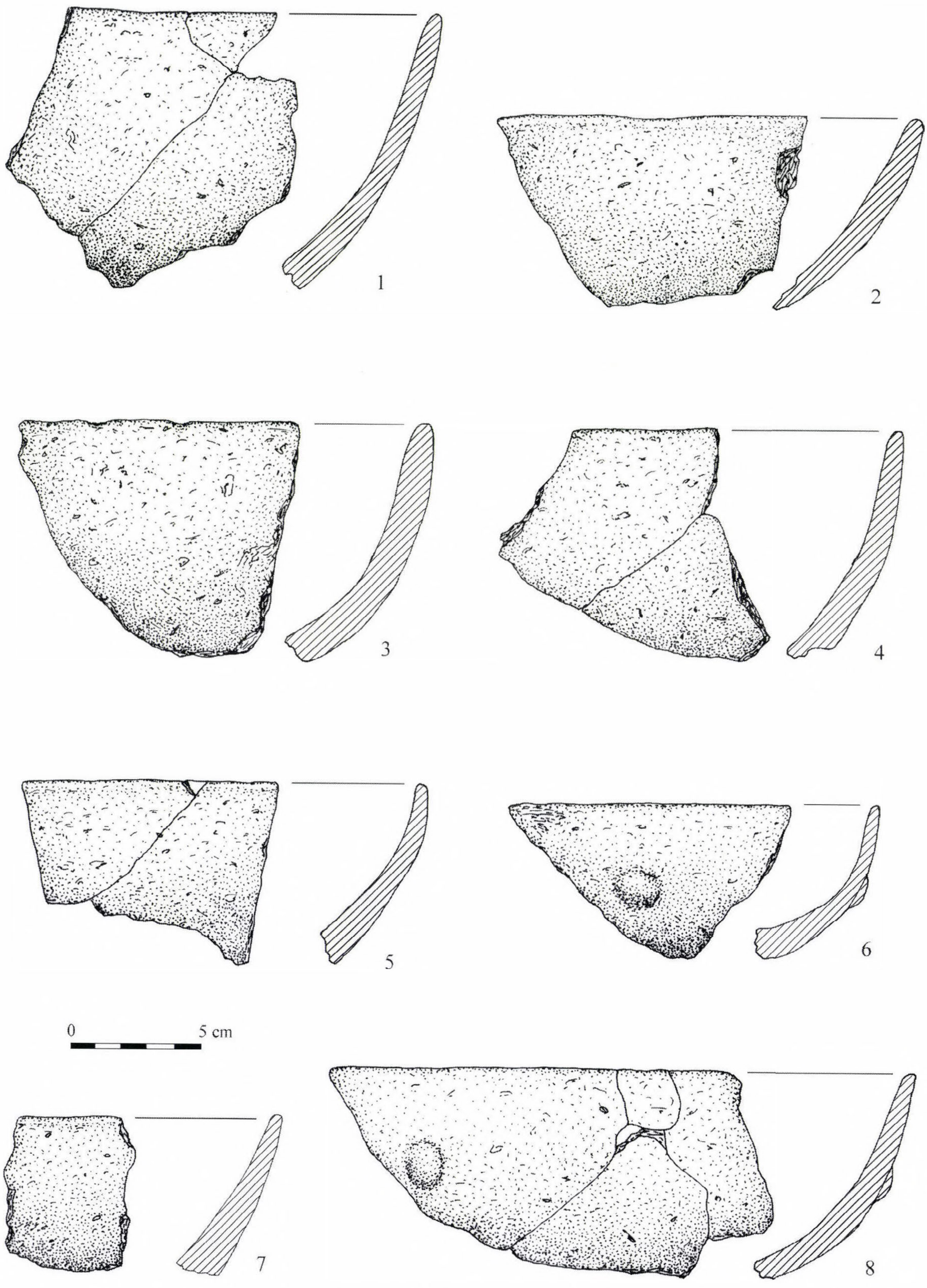


Fig. 27.10. Fragments of globular bowls

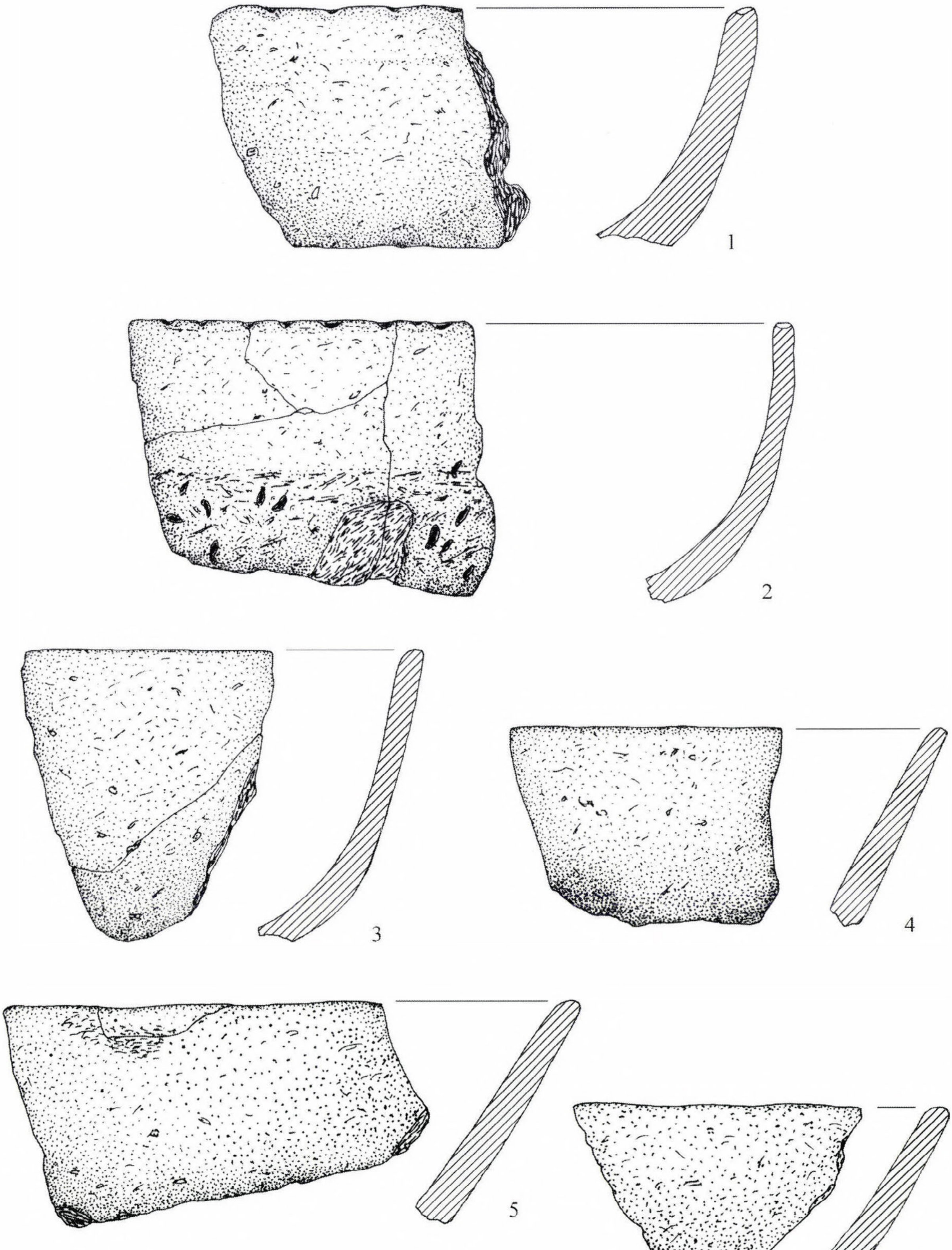


Fig. 27.11. Fragments of globular and conical bowls

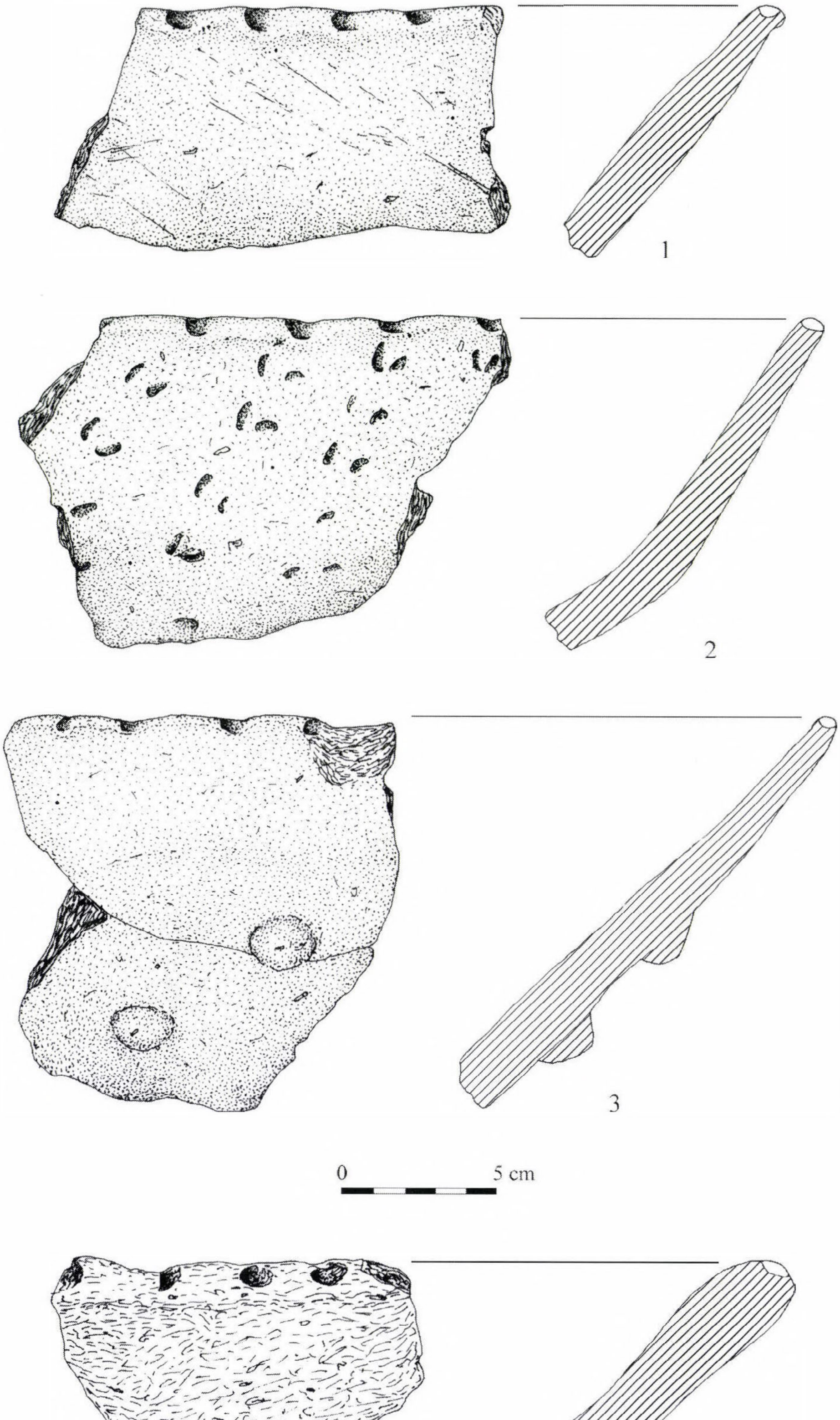
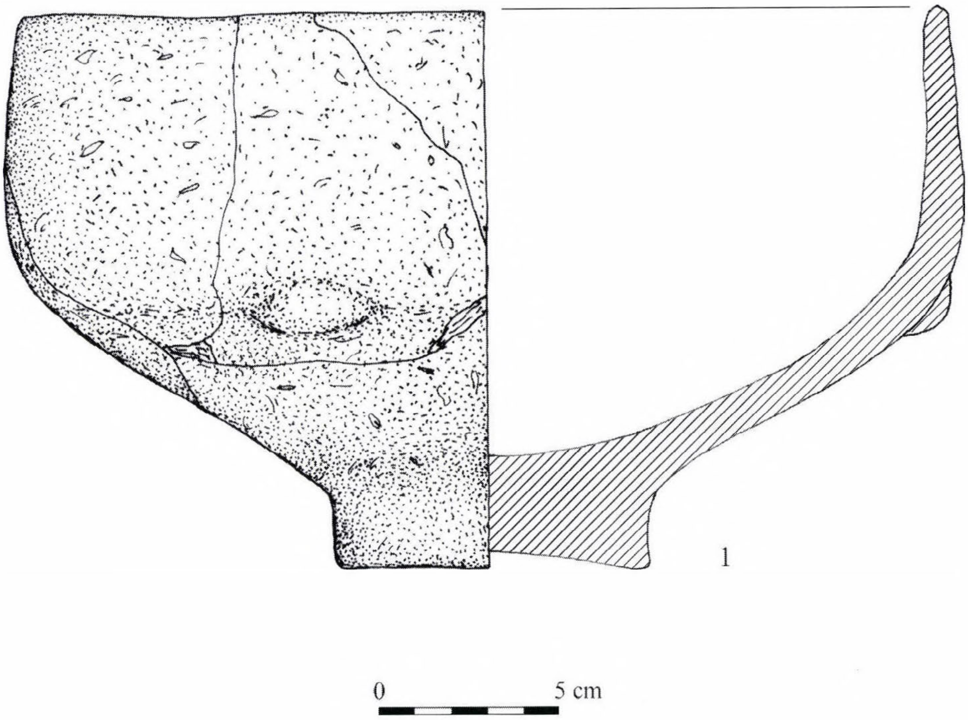


Fig. 27.12. Fragments of large conical and carinated bowls



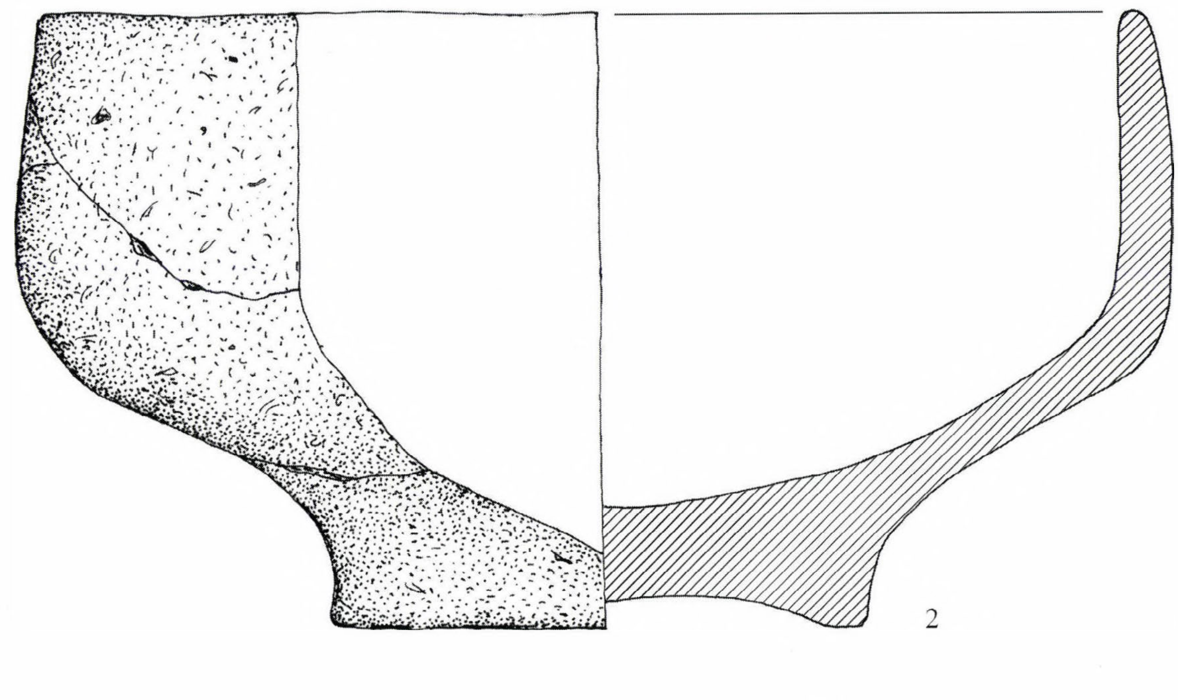


Fig. 27.13. Bowls with cylindrical upper part

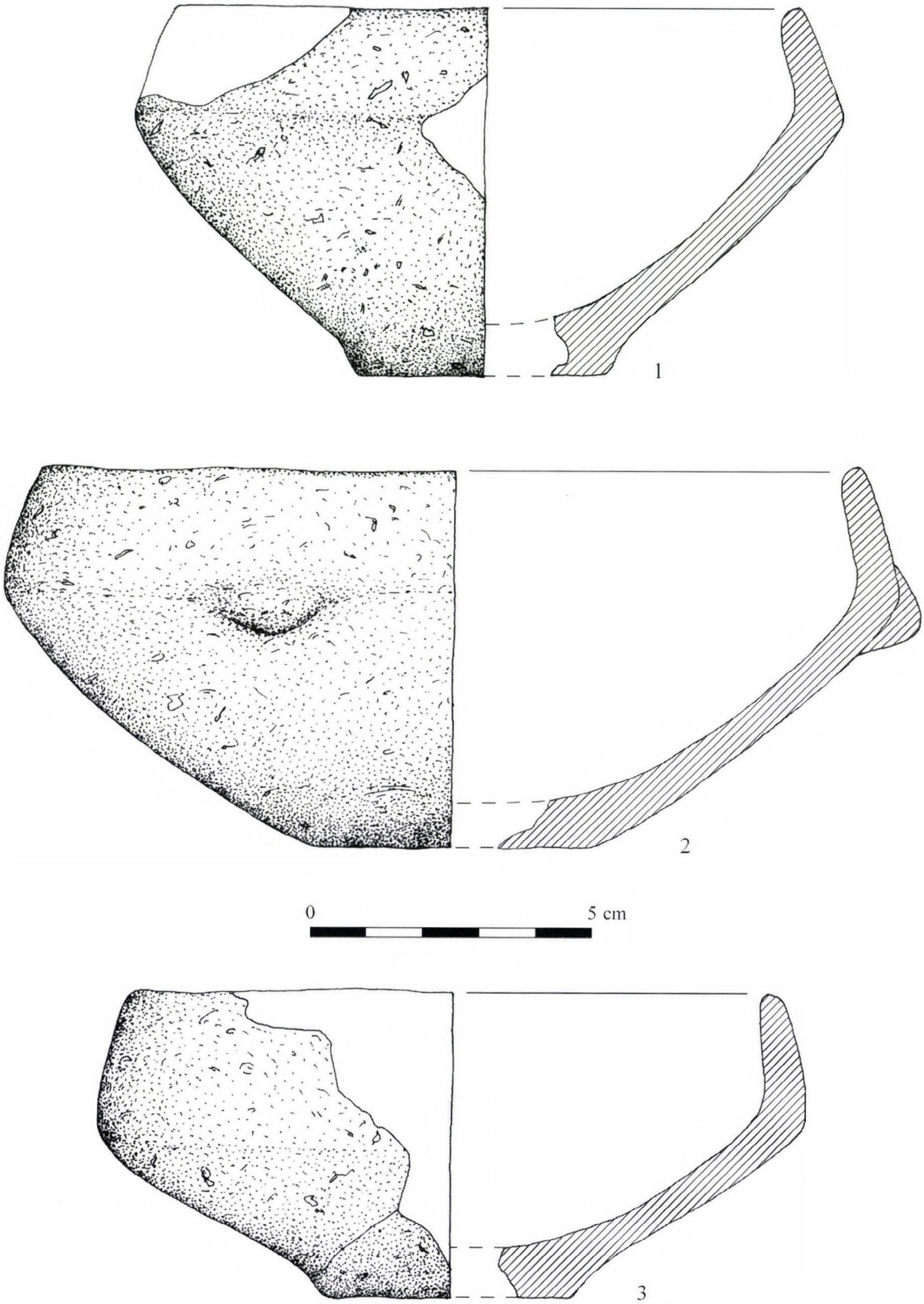


Fig. 27.14. Carinated bowls

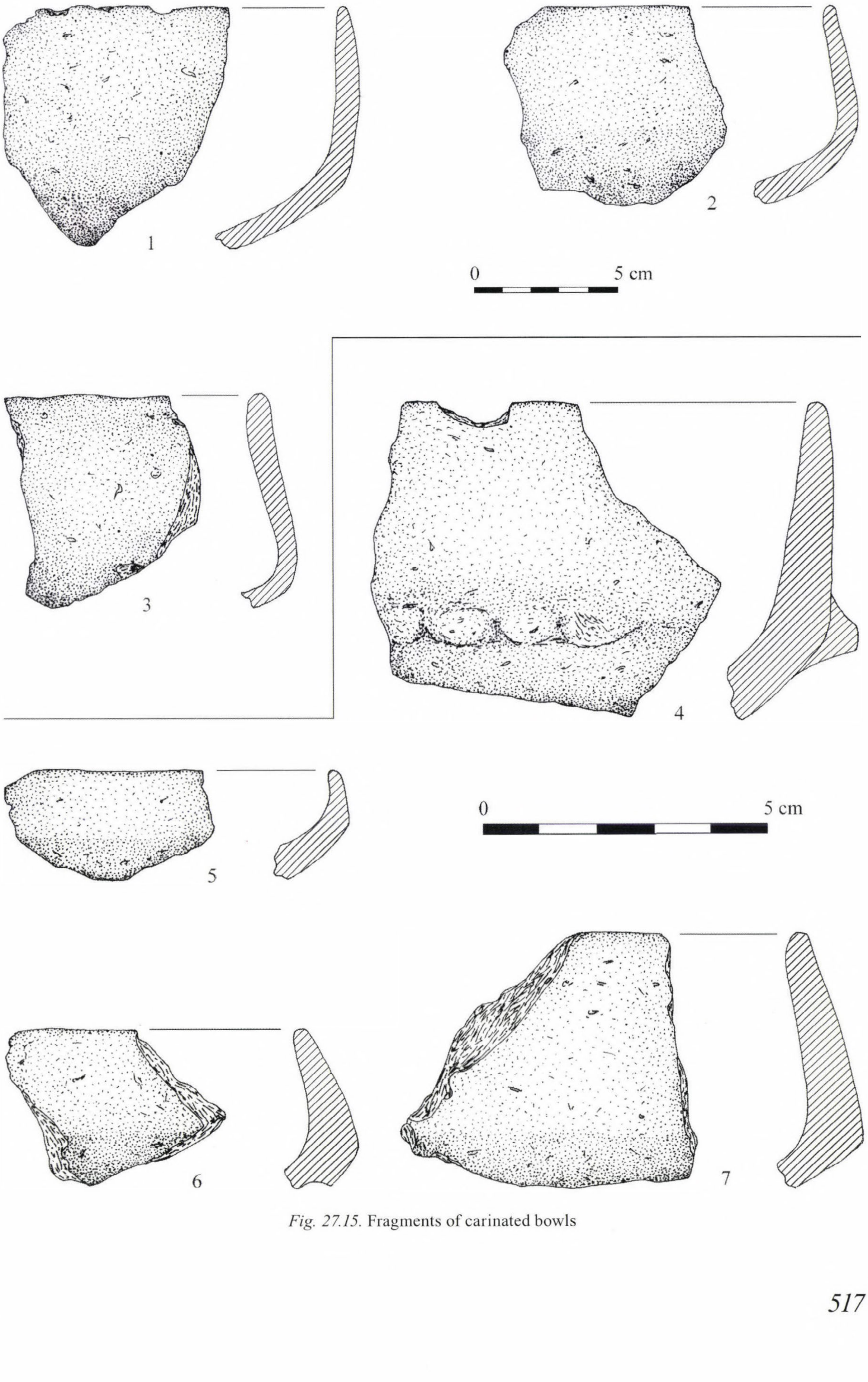


Fig. 27.15. Fragments of carinated bowls

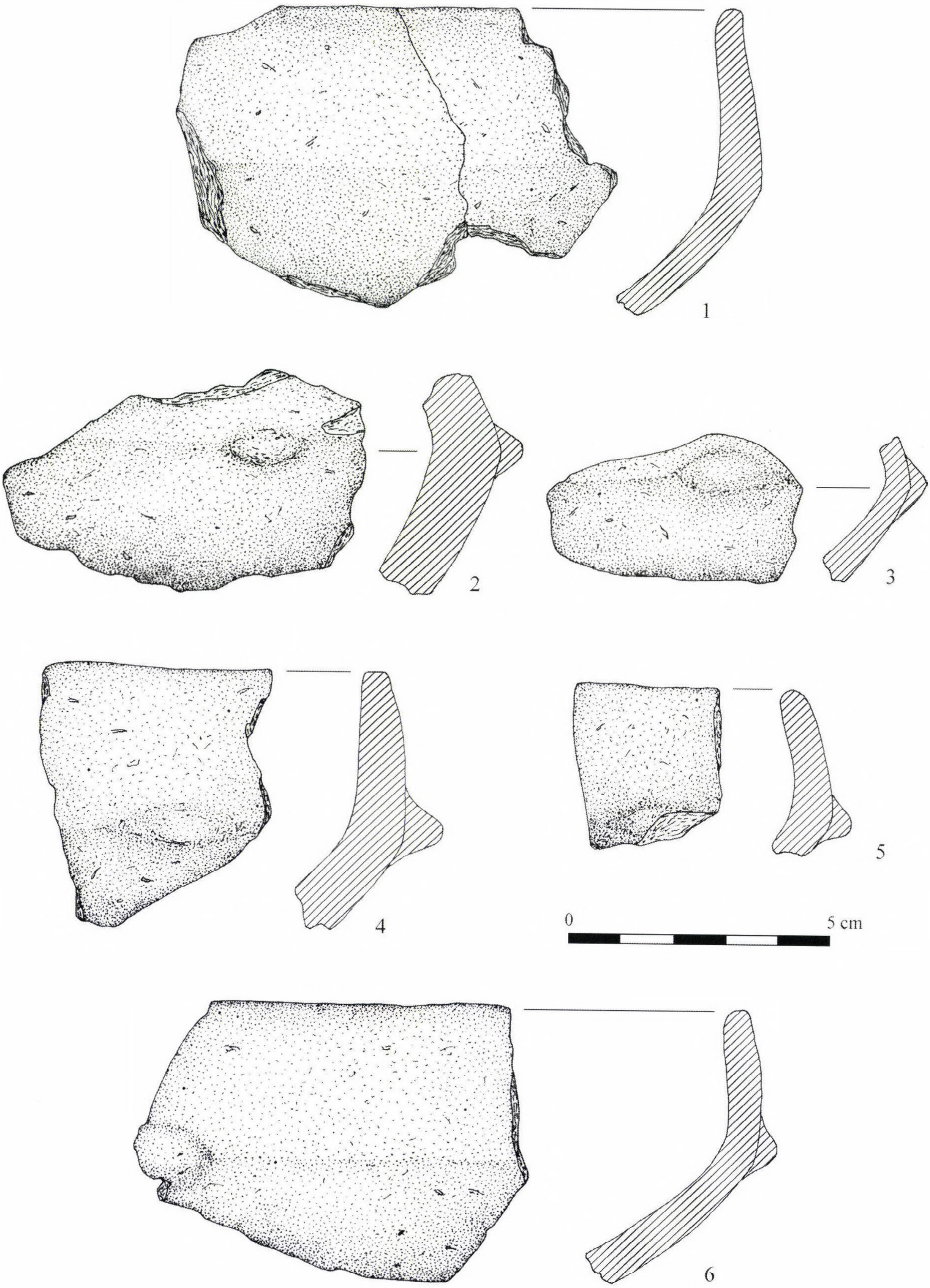


Fig. 27.16. Fragments of carinated bowls

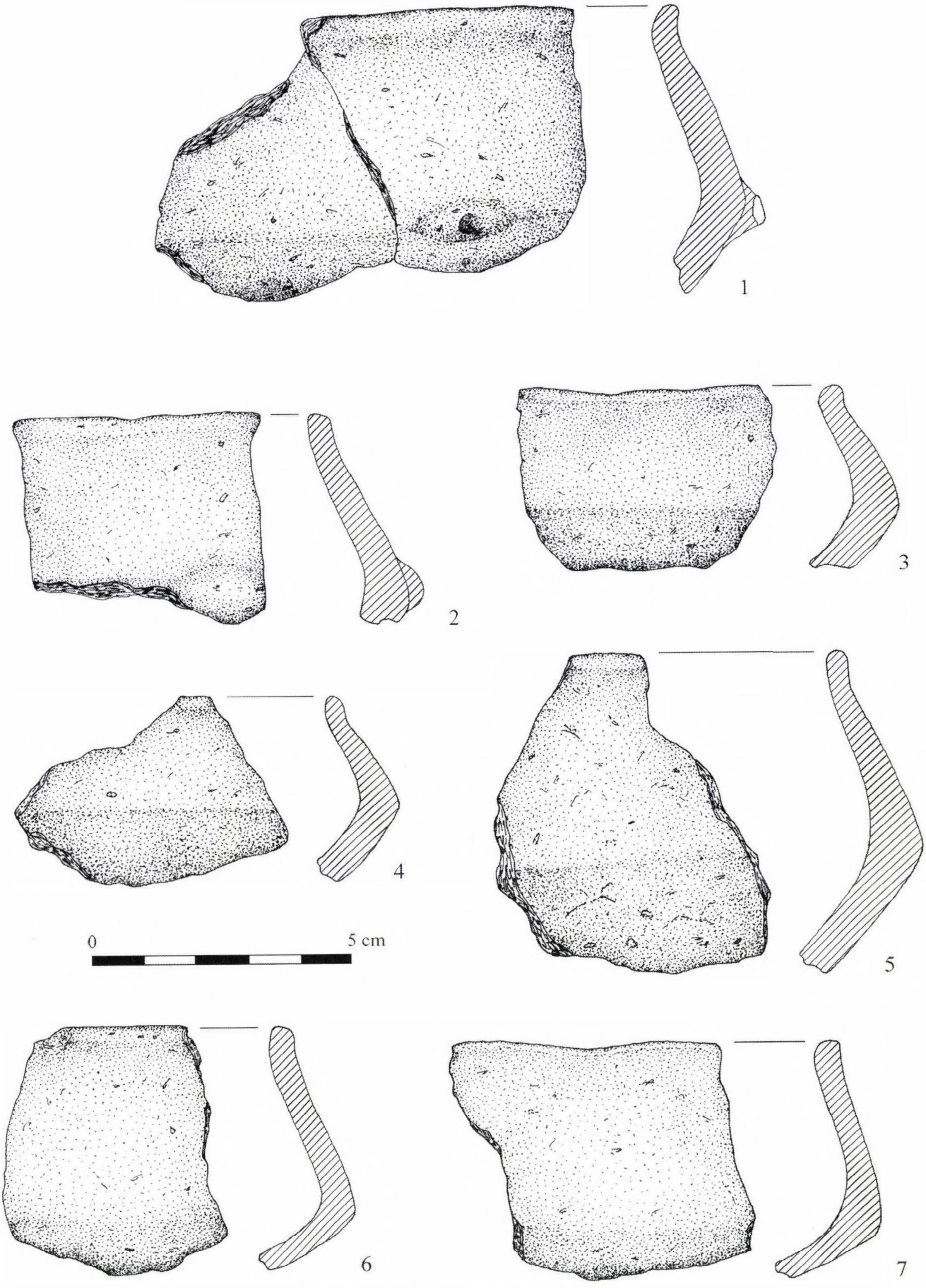


Fig. 27.17. Fragments of carinated bowls

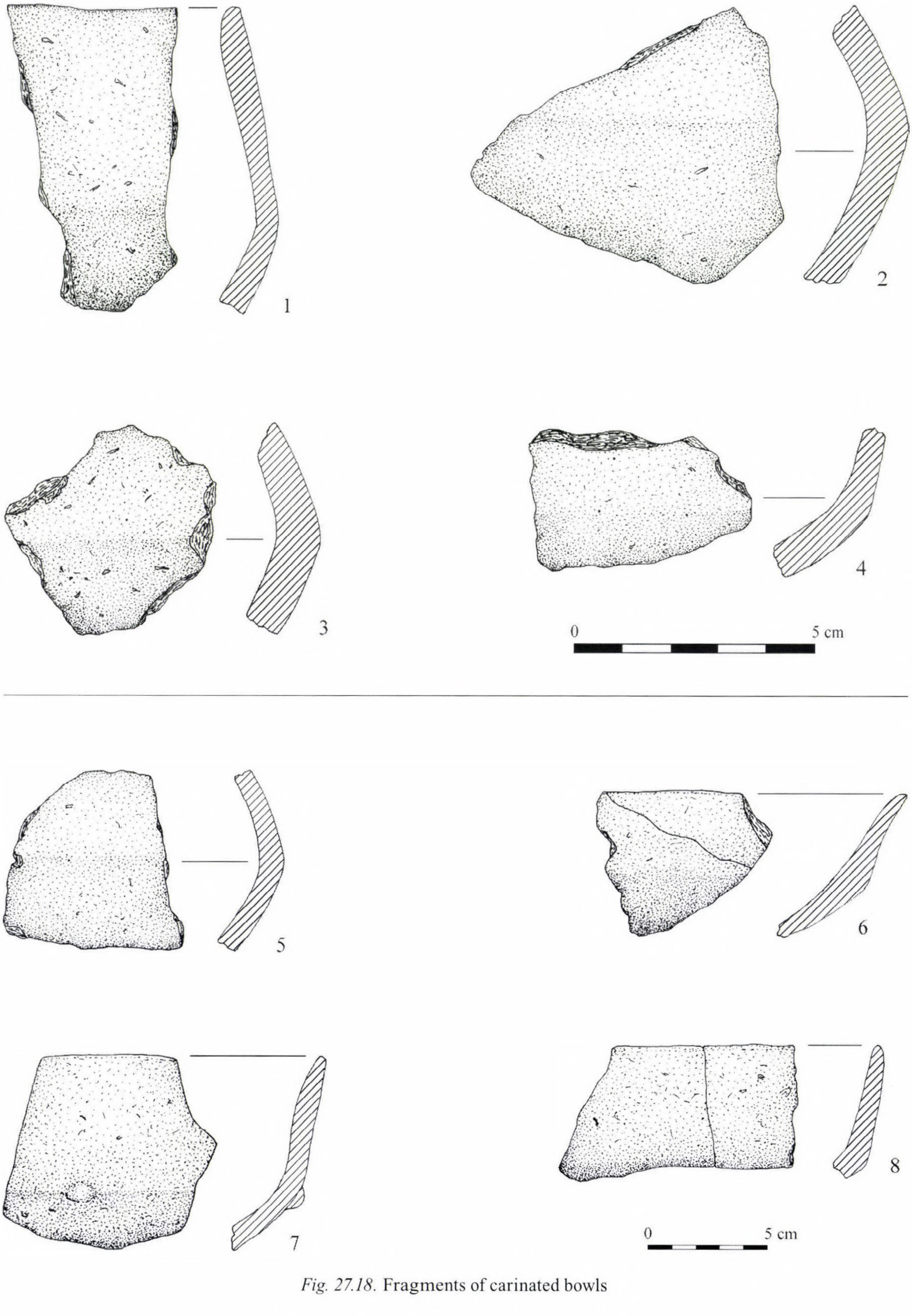


Fig. 27.18. Fragments of carinated bowls

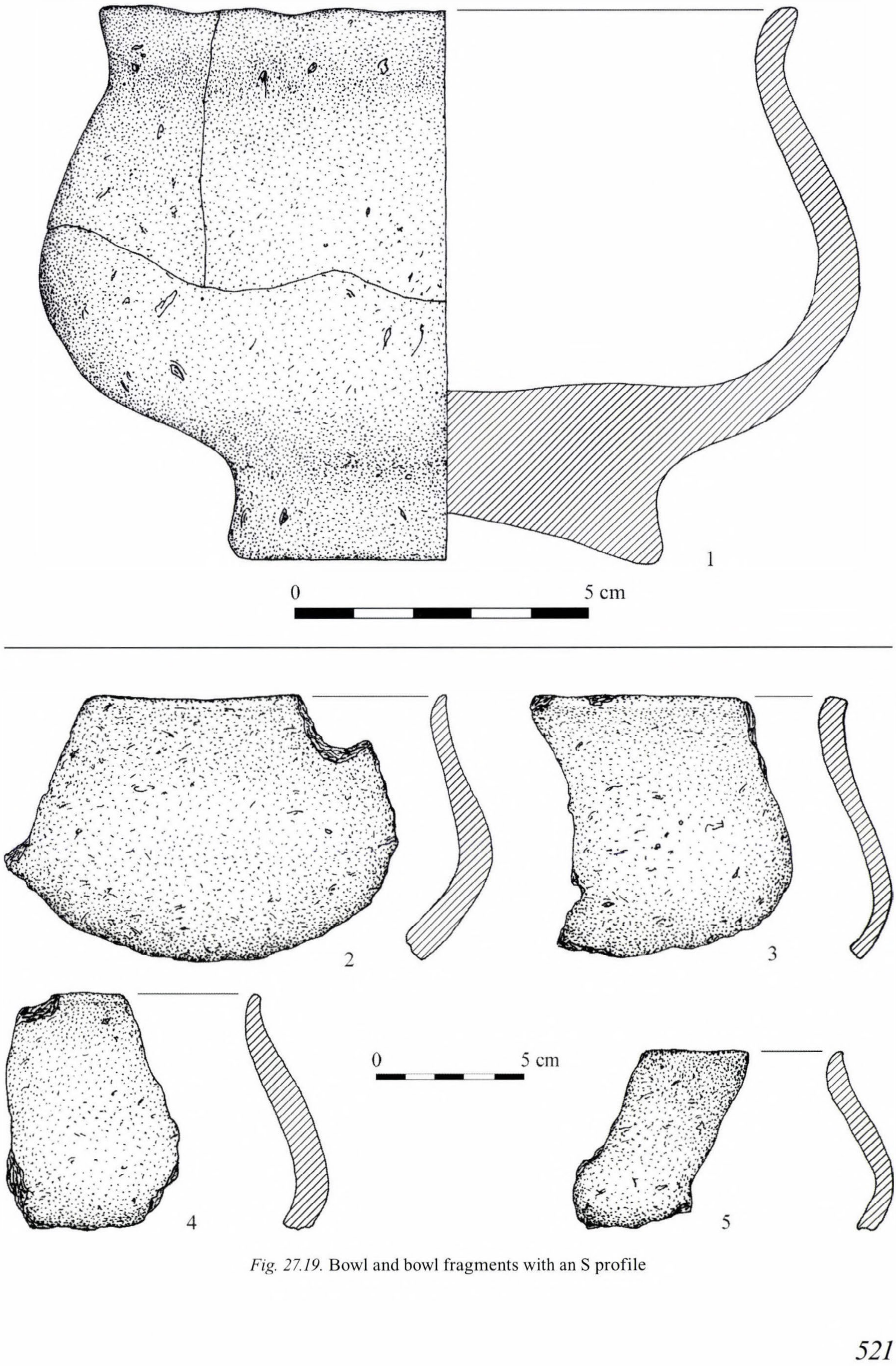


Fig. 27.19. Bowl and bowl fragments with an S profile

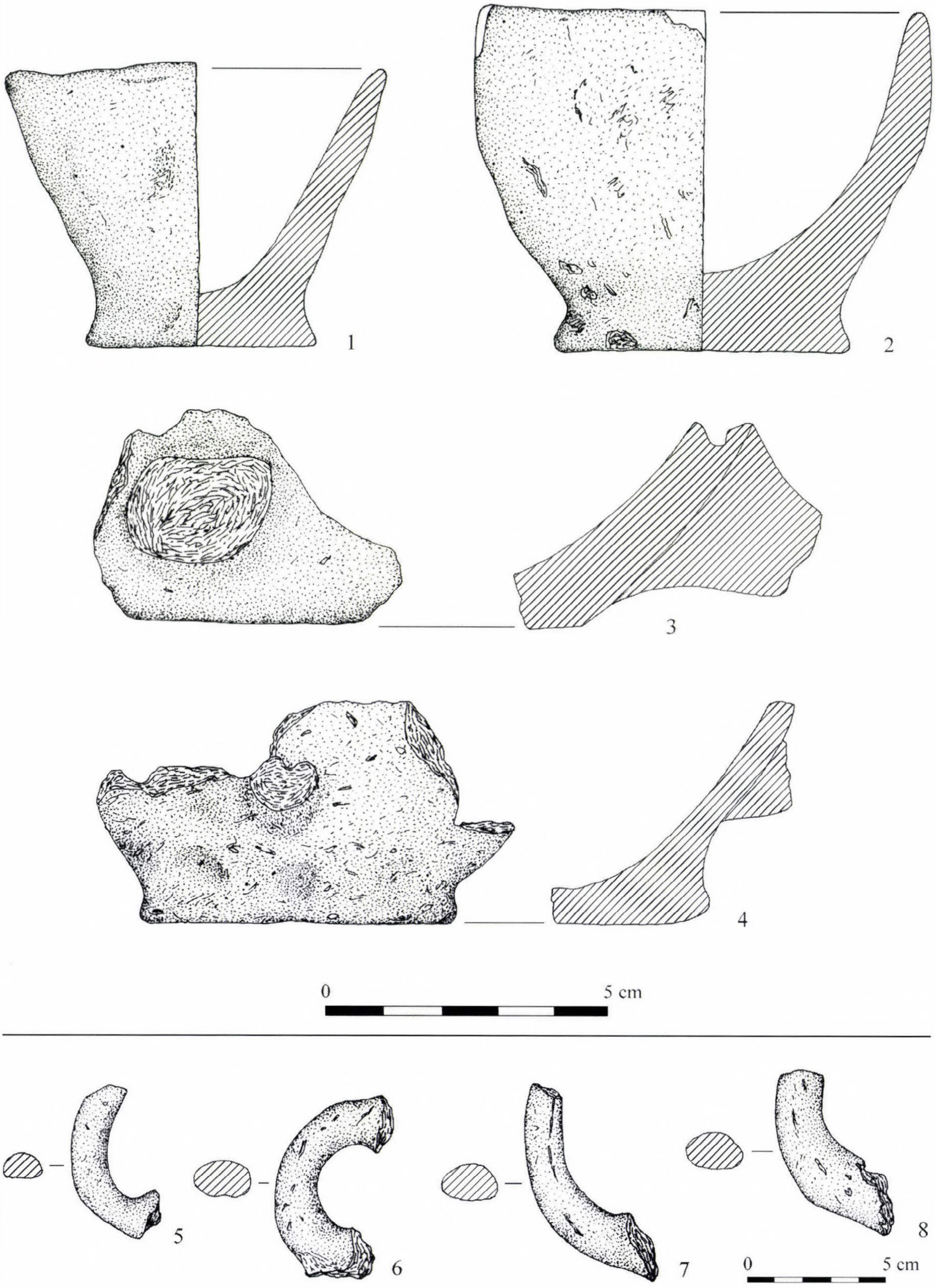


Fig. 27.20. Cups and fragments of handled cups

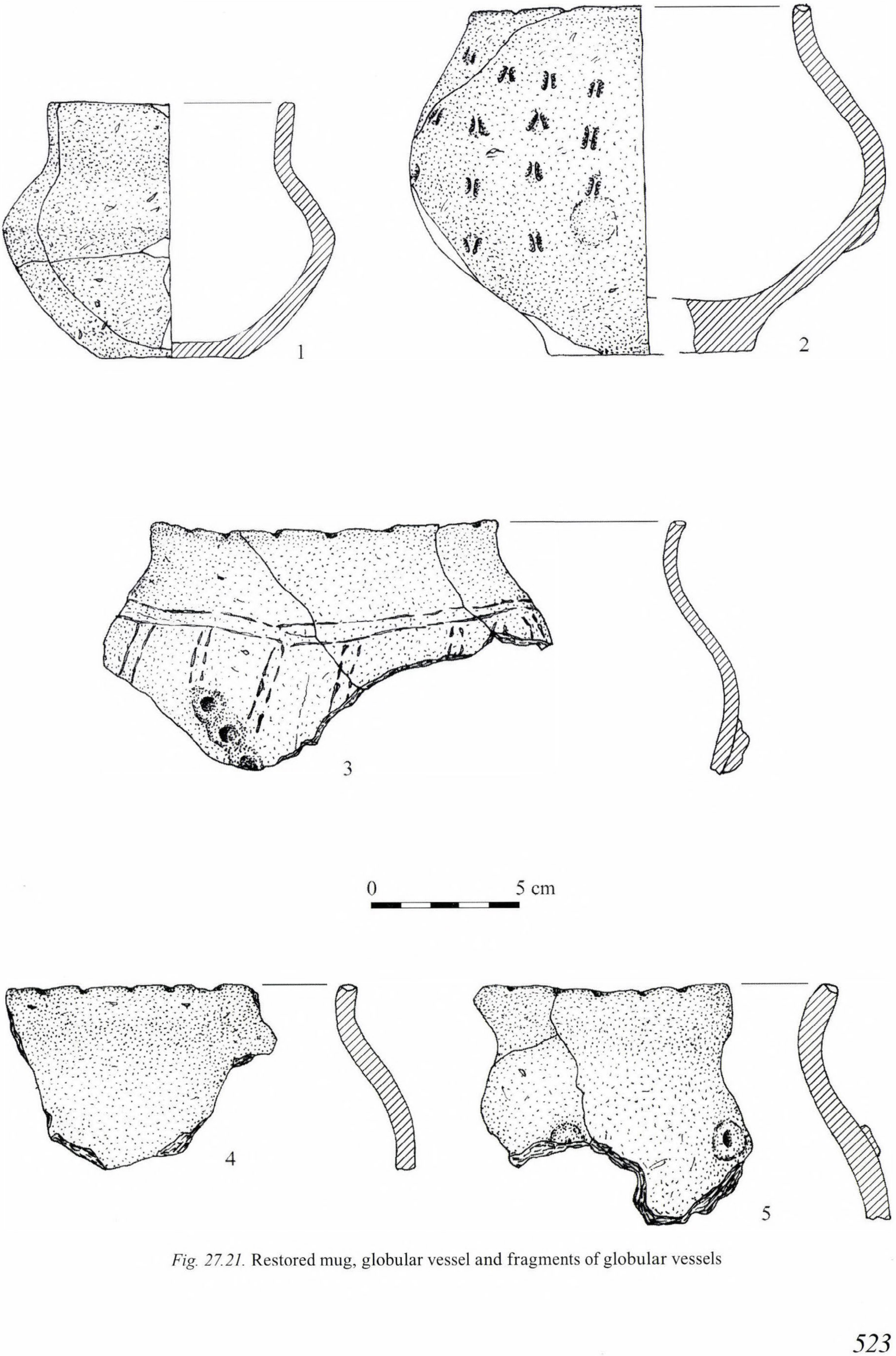


Fig. 27.21. Restored mug, globular vessel and fragments of globular vessels

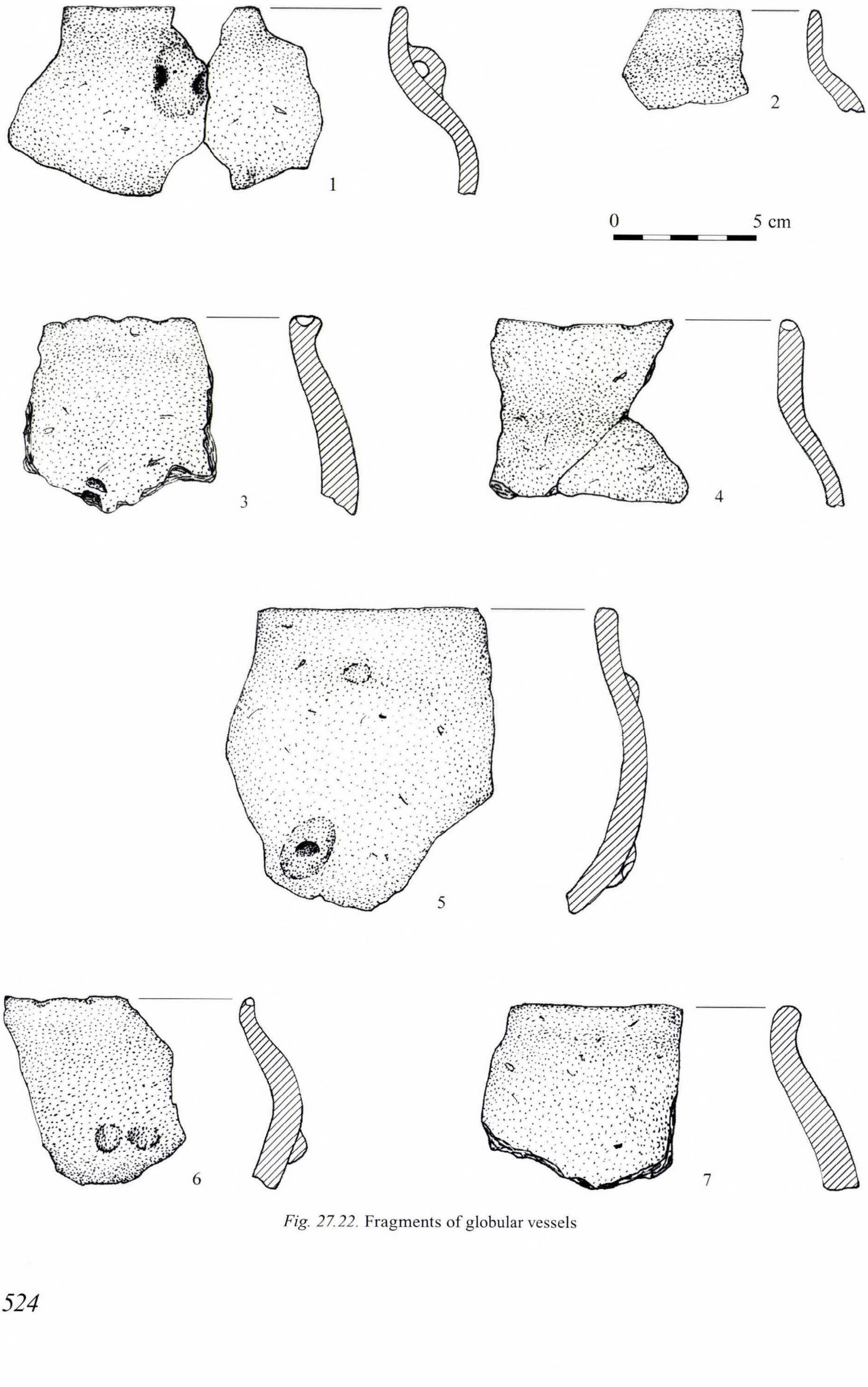


Fig. 27.22. Fragments of globular vessels

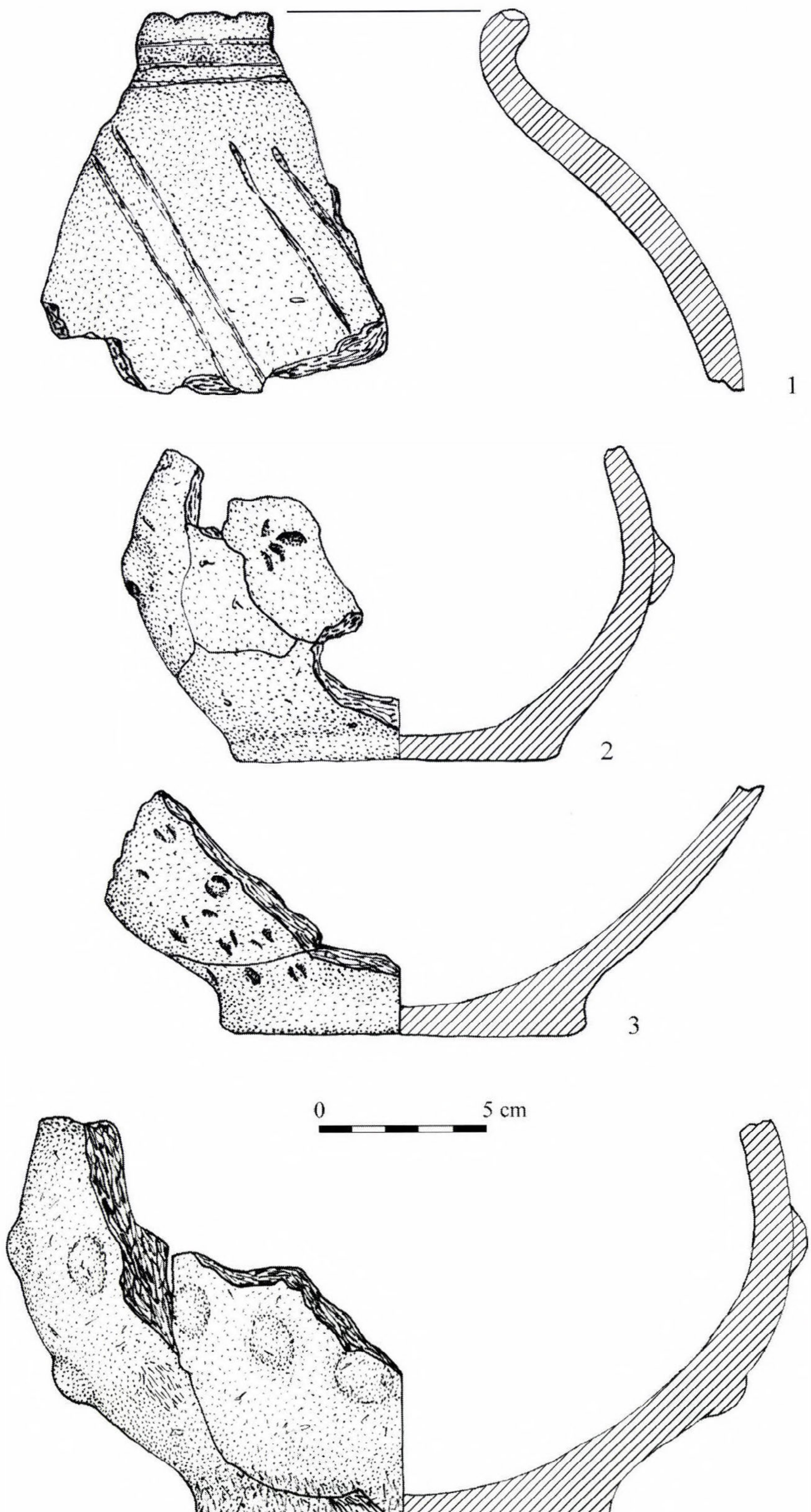


Fig. 27.23. Fragments of globular vessels

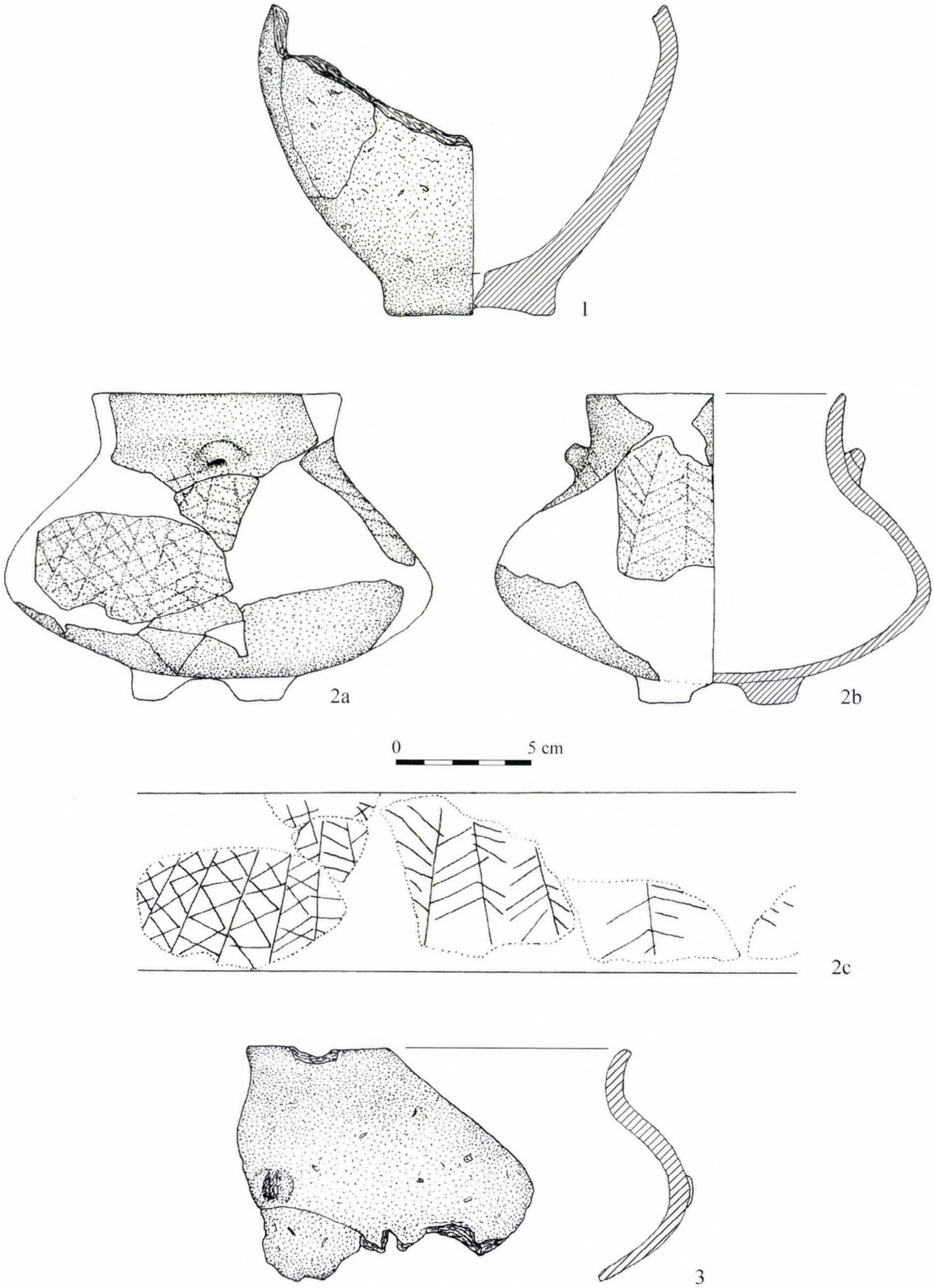


Fig. 27.24. Restored flattened globular vessel, fragments of globular and flattened globular vessels

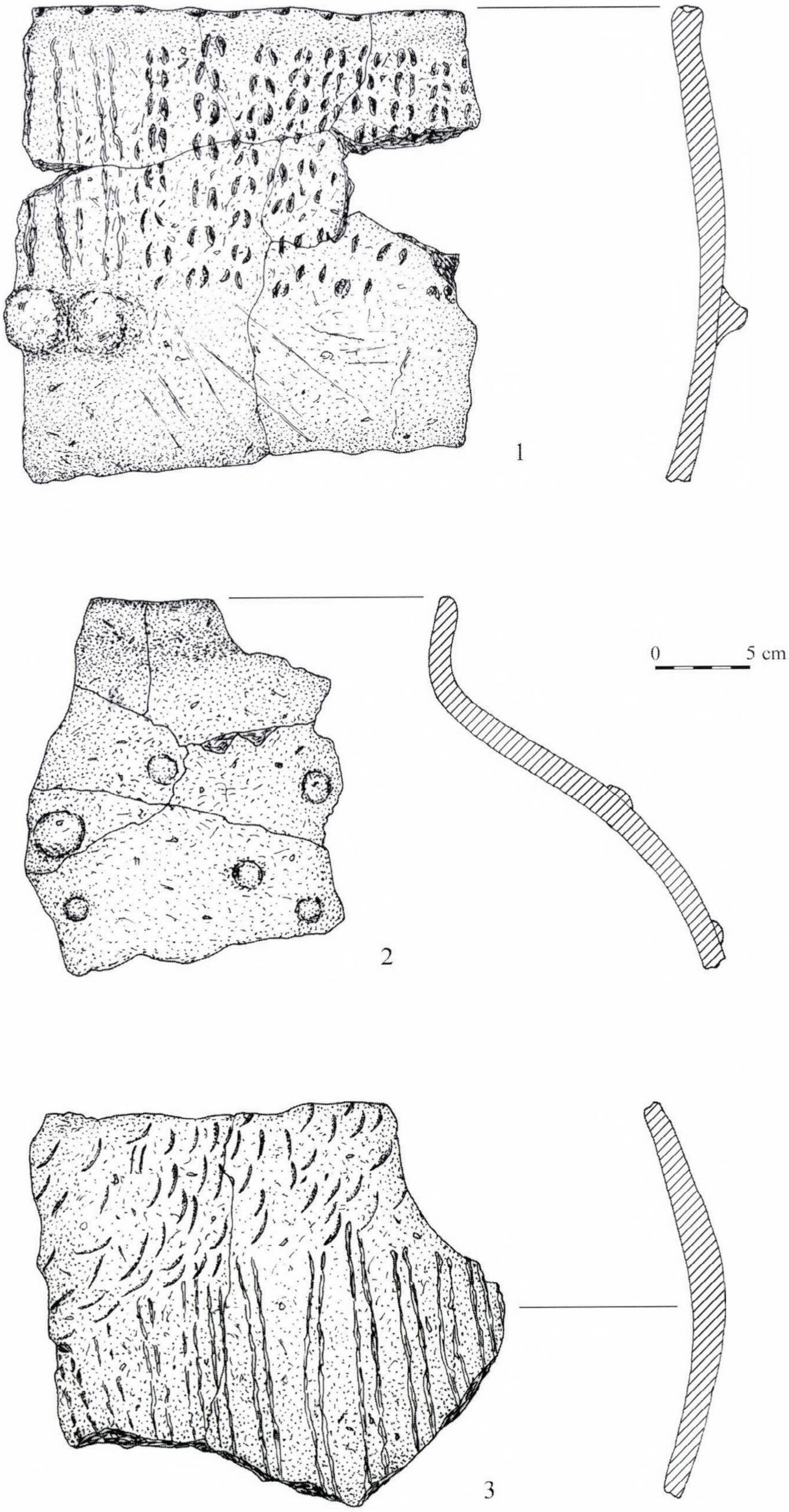


Fig. 27.25. Fragments of storage jars

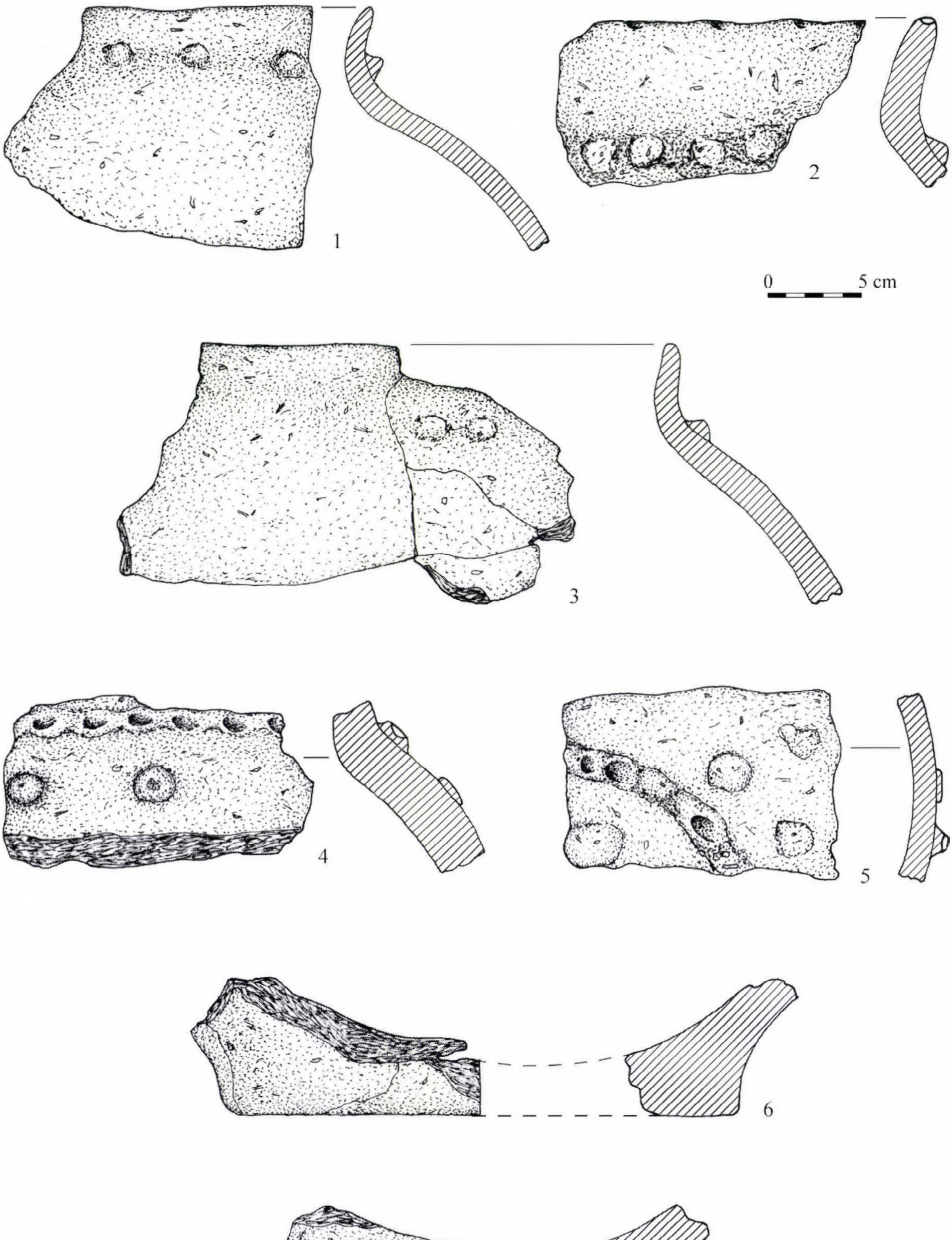


Fig. 27.26. Fragments of storage jars

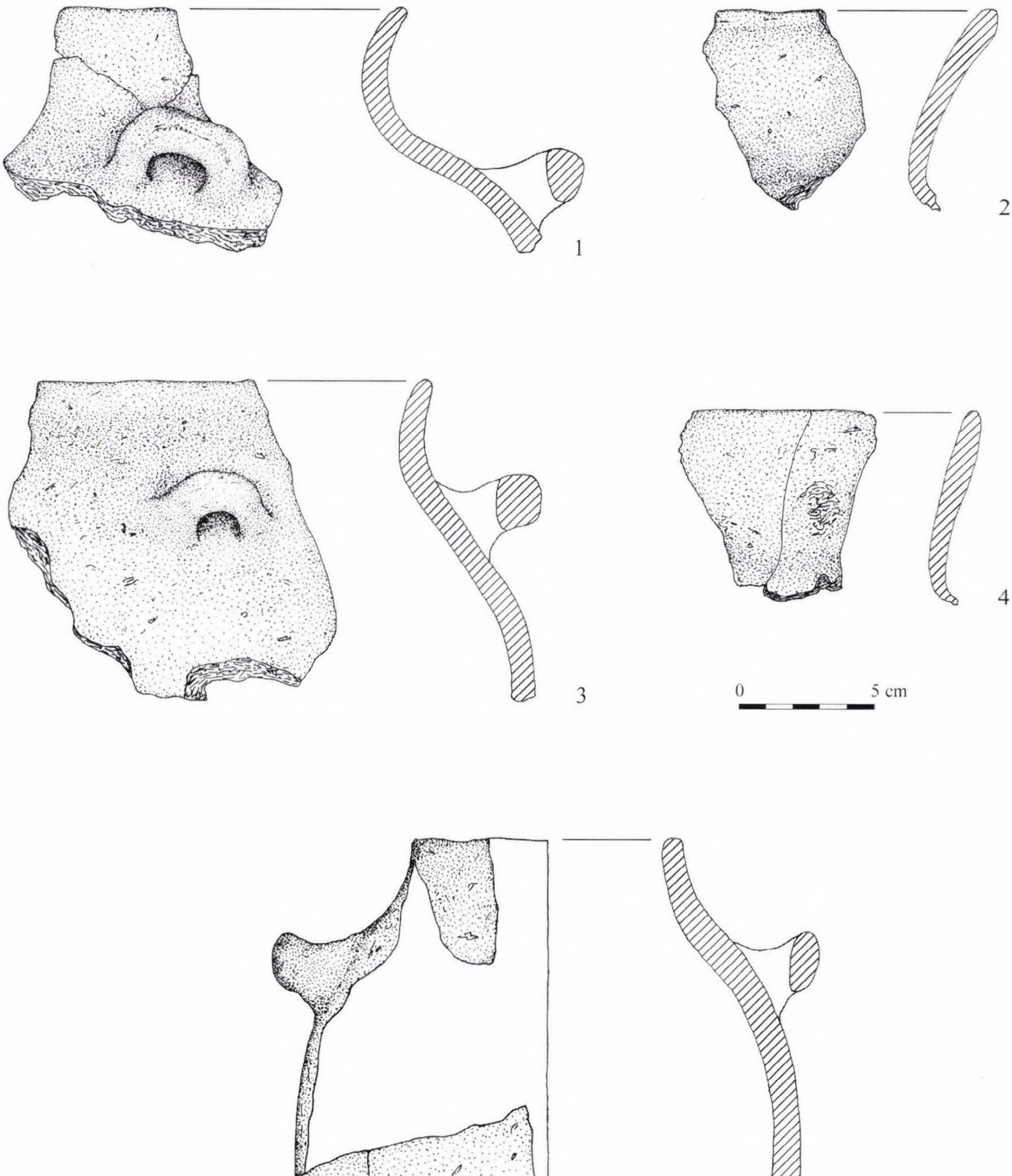


Fig. 27.27. Restored pannier vessel and fragments of pannier vessels

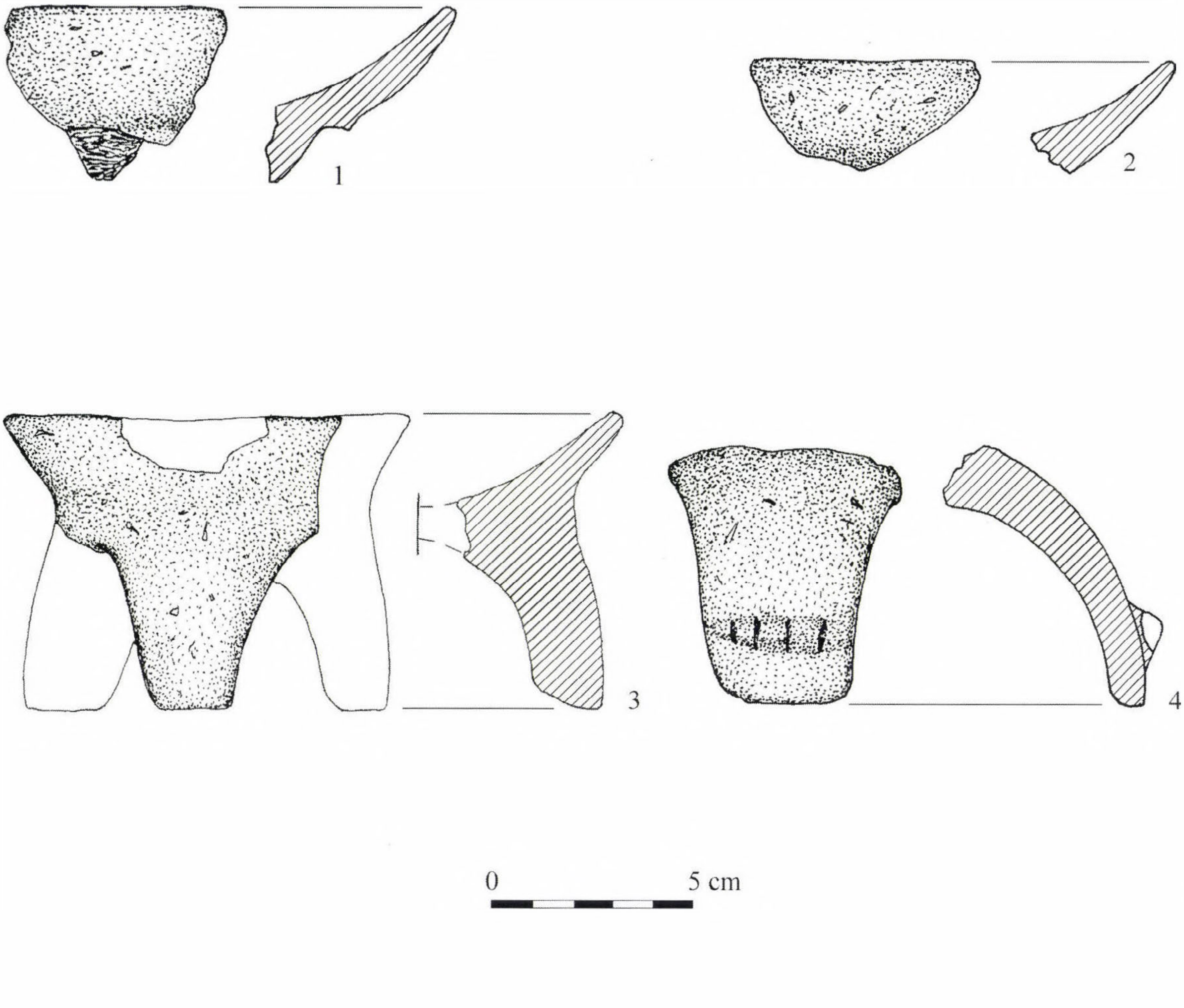


Fig. 27.28. Altars

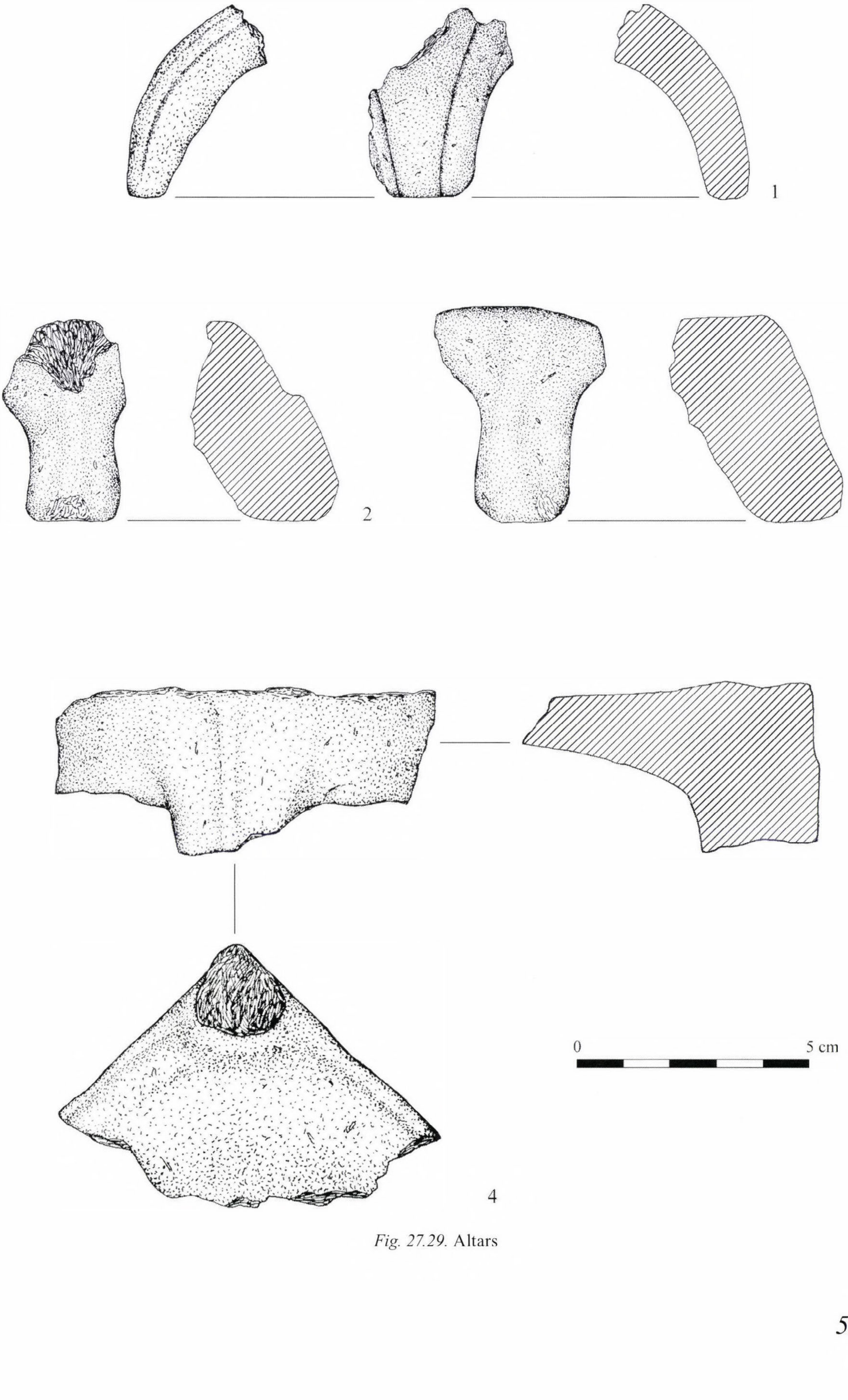


Fig. 27.29. Altars

Fig. 27.30. Flowerpot-shaped vessel and bowls

Fig. 27.31. Bowl with an S profile, cups, mug and globular vessels

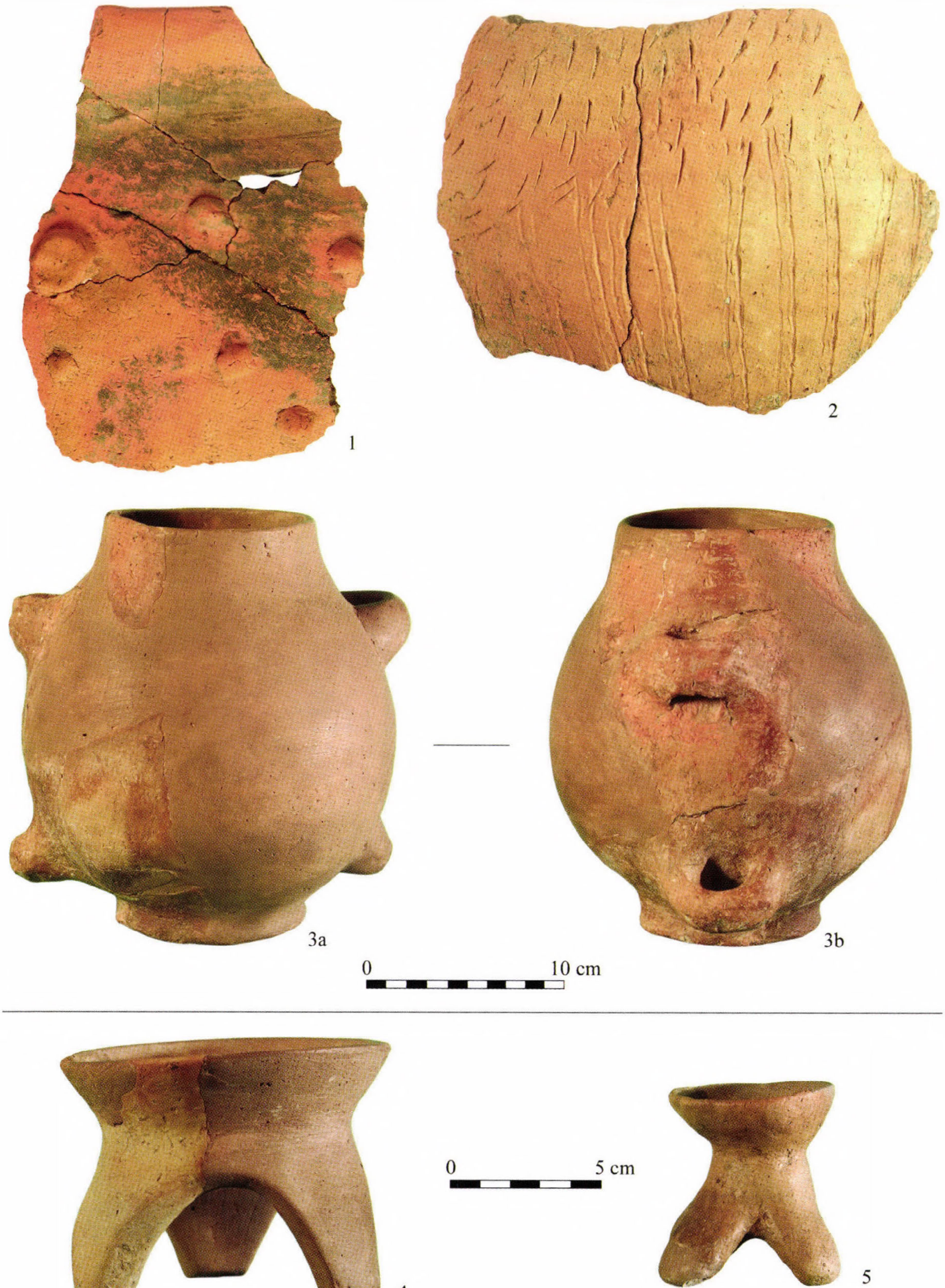


Fig. 27.32. Storage jars, pannier vessel and altars

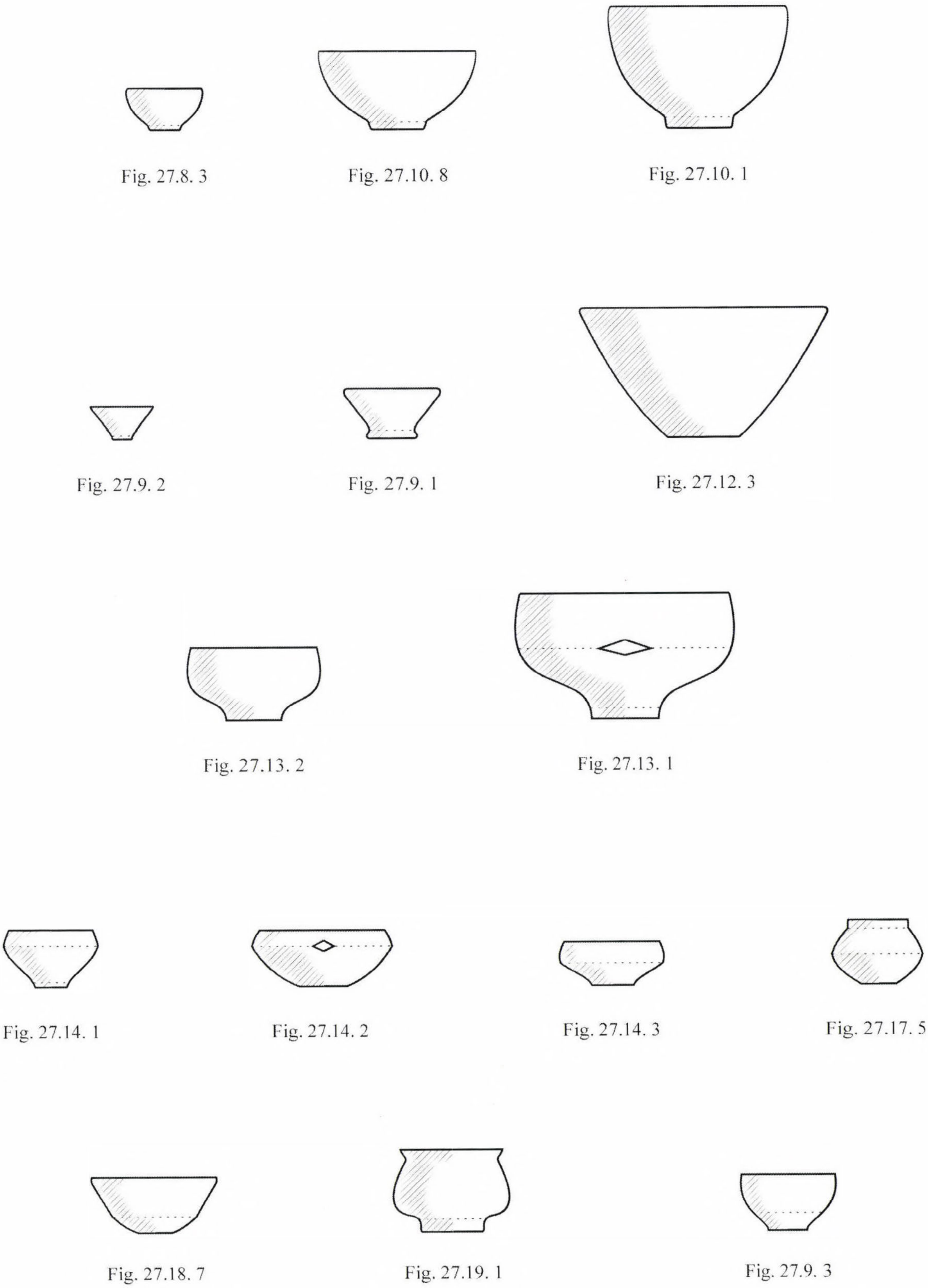


Fig. 27.33. Vessel forms

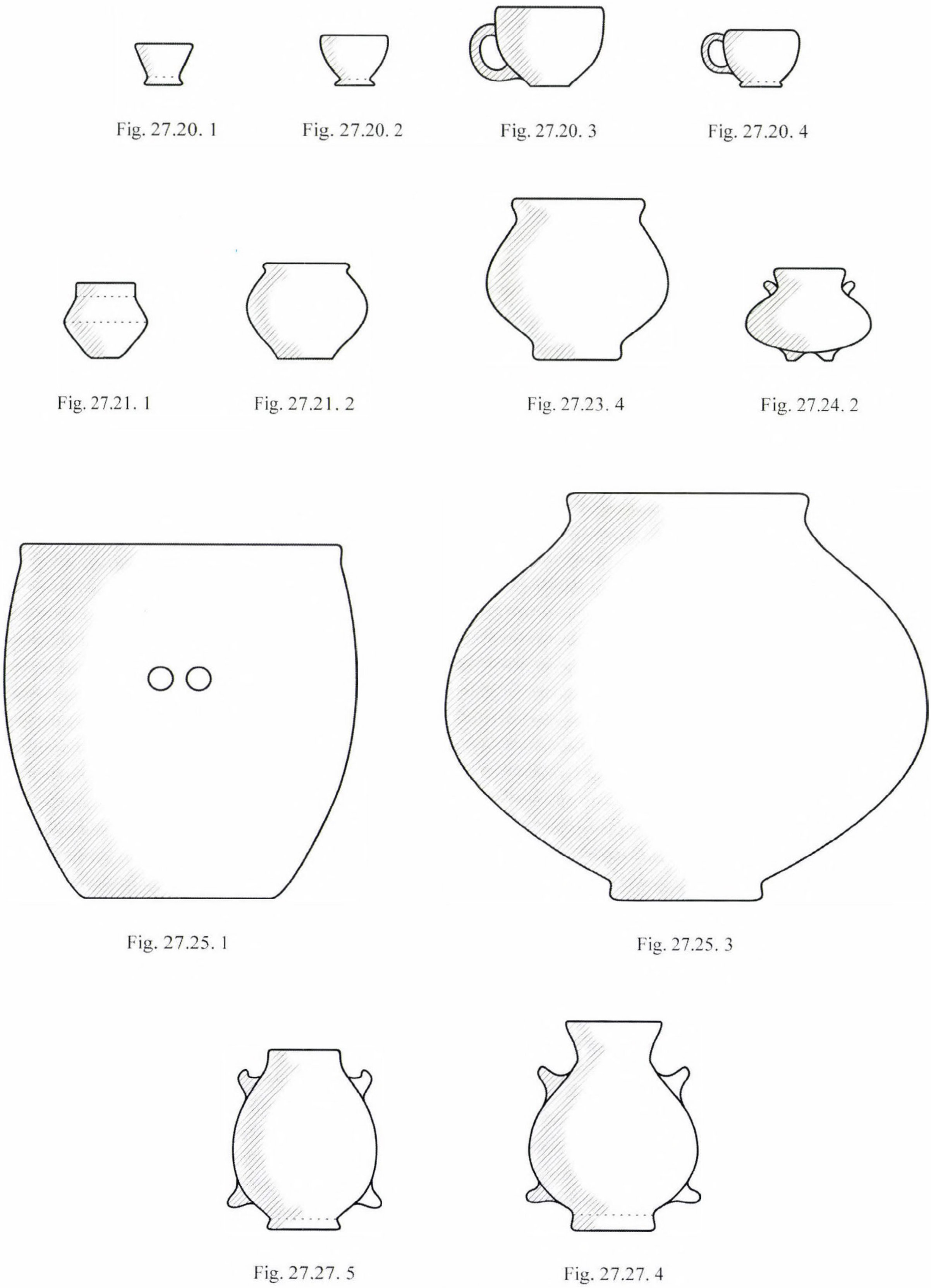


Fig. 27.34. Vessel forms

Impressed decoration

Finger and nail impressions

Although not too widespread, finger- and nail-impressed ornamentation does occur among the finds of the Körös culture (Kutzián 1944, 72). Trench B yielded twelve sherds with finger or nail impressed decoration; the number of fragments bearing an impressed pattern from the three trenches totalled nineteen *(Fig. 27.41. 1–7)*. This accounted for 0.14 per cent of the finds from Trench B and 0.17 per cent of the entire Early Neolithic material. The statistical and stratigraphic analysis of such a small number of finds would have been senseless. According to our present knowledge, this type of decoration has no relevance for the internal chronology of the Körös culture.

Table 27.5. Distribution of pinched decoration in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Pinched decoration	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	102	20.99
2. upper occupation level	2.1	1518	17.82	79	16.25
	2.2	912	10.71	55	11.32
	2.3	1774	20.83	108	22.22
3. occupation levels over contexts 390/394/395	3.1	422	4.95	22	4.53
	3.2	597	7.01	35	7.20
	3.3	368	4.32	21	4.32
	3.4	232	2.72	9	1.85
4. pit fill	4.1	1196	14.04	47	9.67
5. basal levels and pits	5.1	147	1.73	5	1.03
Without stratigraphic context		101	1.19	3	0.62
Total		**8517**	**100**	**486**	**100**

Pinched decoration

The most popular ornamentation on Körös pottery was made by pinching; the potter created patterns by pinching the clay with the thumb and the forefinger. Fragments ornamented using this technique occur in great number on all Körös sites in Hungary. This decoration is sometimes sparsely applied, but it very often covers the entire vessel body. The widespread occurrence of this distinctive ornamental technique enabled the identification of the culture's pottery at a relatively early date. Vessels decorated with pinching occur abundantly at Ecsegfalva *(Fig. 27.21. 2, Fig. 27.23. 2–3, Fig. 27.42. 1–8)*. Trench B yielded a total of 486 joined sherds, accounting for 5.71 per cent of the finds. The distribution of wares with pinched decoration in Trench B is shown in *Table 27.5* and *Fig. 27.35*.

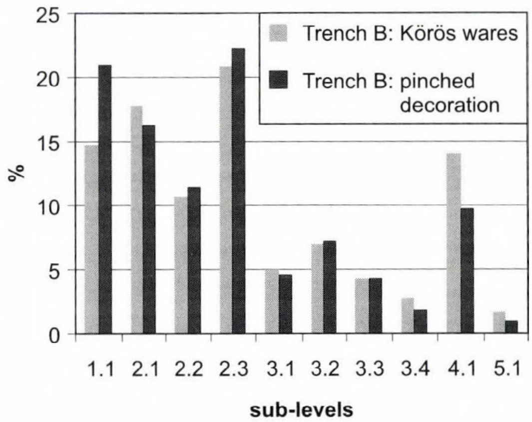


Fig. 27.35. Distribution of pinched decoration in the Körös assemblage from Ecsegfalva 23, Trench B

The distribution of pottery with pinched decoration corresponds to the general distribution of Körös pottery in the various levels of Trench B, the only exceptions being levels 1 (topsoil) and 4 (pit fill). The former has a higher proportion of pinched decoration, the latter a lower one. We may therefore say that there was no substantial change in the application of pinched decoration in the settlement's life-span and that this decoration was present throughout the sequence. The same observation was made on other Körös sites, this being the reason for the general consensus among prehistorians that this decoration is unsuitable for refining the internal chronology of the Körös culture.

Spike motif

Spike motifs were made using the same technique as pinched decoration, the single difference being that a pattern of one or more rows was created. According to Kutzián (Kutzián 1944, 72) this pattern was first described as a spike pattern by Ede Krecsmárik (Krecsmárik 1915, 26).[9] Similarly to Banner (Banner 1929, 31–32), Kutzián too regarded spike motifs as a variant of pinched decoration (Kutzián 1944, 72–73). Pottery decorated with spike motifs has been found on many Körös sites,

Table 27.6. Distribution of spike motif patterns in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Spike motif	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	15	13.39
2. upper occupation level	2.1	1518	17.82	23	20.53
	2.2	912	10.71	17	15.18
	2.3	1774	20.83	20	17.86
3. occupation levels over contexts 390/394/395	3.1	422	4.95	4	3.57
	3.2	597	7.01	10	8.93
	3.3	368	4.32	2	1.79
	3.4	232	2.72	3	2.68
4. pit fill	4.1	1196	14.04	18	16.07
5. basal levels and pits	5.1	147	1.73	0	0
Without stratigraphic context		101	1.19	0	0
Total		**8517**	**100**	**112**	**100**

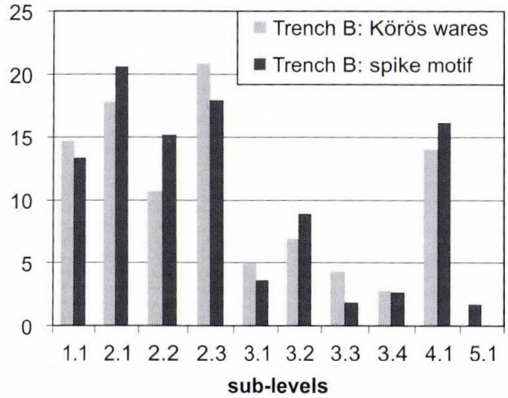


Fig. 27.36. Distribution of spike motif patterns in the Körös assemblage from Ecsegfalva 23, Trench B

e.g. at Endrőd 119-Öregszőlők (Makkay 1992, pl. 17. 1) Gyoma-Csudabala (Kutzián 1944, pl. XII. 7), Gyula-Vasúti homokbánya (Kutzián 1944, pl. XIV. 17–18), Hódmezővásárhely-Kopáncs-Kovács-tanya (Kutzián 1944, pl. XXXIX. 13–14), Szentes-Nagyhegy (Kutzián 1944, pl. XVII. 15), Szentes-Nagyjaksorpart (Kutzián 1944, pl. XXXIX. 15, pl. XL. 4), Szarvas-Szappanos (Krecsmárik 1915, 27, figs 49–51; Kutzián 1944, pl. XXXIX. 16–18, 20), and Tiszaug-Tópart (Kutzián 1944, pl. VI. 9). Altogether 112 joined sherds from Trench B can be assigned to this category *(Fig. 27.43. 1–6)*, representing 1.32 per cent of the pottery recovered from this trench, which can hardly be regarded as a statistically relevant number. The distribution of pottery decorated with spike motifs is shown in *Table 27.6* and *Fig. 27.36.*

Similarly to the overall distribution of Körös pottery, the highest number of fragments bearing a spike motif pattern occurred in the topsoil (1), the upper occupation level (2) and the pit fill (4). Smaller variations can be noted; thus, for example, the percentage of pottery decorated with spike motifs is outstandingly high in sub-level 2.2. This decoration is absent from the basal levels and pits (5), which yielded 1.73 per cent of all the finds. Pottery decorated with spike motifs thus occurs throughout the settlement's life-span (with the exception of the basal levels) and its distribution corresponds to the general distribution of the pottery.

Spike motifs arranged into pairs of rows

On some fragments, spike motifs are set into pairs of straight or slightly wavy lines *(Fig. 27.44. 1–7).* The thirty-two joined sherds from Trench B account for 0.38 per cent of the ceramic assemblage. The distribution of this pattern is shown in *Table 27.7* and *Fig. 27.37.*

Table 27.7. Distribution of spike motifs arranged into pairs of rows in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Spike motifs arranged into pairs of rows	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	2	6.25
2. upper occupation level	2.1	1518	17.82	8	25
	2.2	912	10.71	3	9.375
	2.3	1774	20.83	6	18.75
3. occupation levels over contexts 390/394/395	3.1	422	4.95	0	0
	3.2	597	7.01	3	9.375
	3.3	368	4.32	2	6.25
	3.4	232	2.72	1	3.125
4. pit fill	4.1	1196	14.04	5	15.625
5. basal levels and pits	5.1	147	1.73	1	3.125
Without stratigraphic context		101	1.19	1	3.125
Total		**8517**	**100**	**32**	**100**

In some sub-levels, the distribution frequency of spike motifs arranged into pairs of rows resembles the general distribution frequency of pottery (sub-levels 2.2, 2.3, 3.4 and 4.1), while in others a substantial difference can be noted (sub-levels 1.1 and 3.1). Knowing that one single sherd bearing this patterns corresponds to 3.125 per cent, there is a danger that these percentages present a distorted picture. This table is a good illustration of the reliability of this statistical approach and, also, of its limitations. Bearing this in mind, we may say that the occurrence of this decorative pattern in the overall ceramic assemblage and its distribution in the layer sequence corresponds to the general distribution frequencies of the pottery finds.

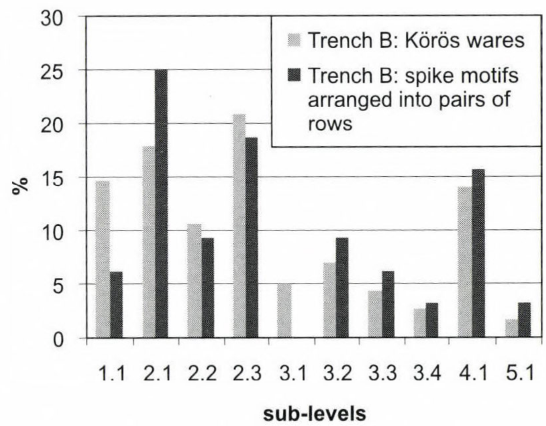


Fig. 27.37. Distribution of spike motifs arranged into pairs of rows in the Körös assemblage from Ecsegfalva 23, Trench B

Mussel impressions

Two joined sherds in the ceramic assemblage are decorated with mussel impressions. One of these comes from a storage jar, on which the mussel impressions occur together with incised lines *(Fig. 27.25. 3, Fig. 27.32. 2)*. The other is a smaller body sherd *(Fig. 27.44. 8)*. In the latter case, it is also possible that the decoration is in fact made up of stronger and longer nail impressions.

Grooved decoration

Some of the pottery fragments are decorated with 0.7–3 cm long grooves, ranging from light *(Fig. 27.45. 1)* to wide, deep ones *(Fig. 27.45. 2–8)*. This is a rare ornamental mode among the finds from Ecsegfalva. Eighteen sherds decorated in this manner occur in the Körös material. Interestingly enough, most of the pottery fragments in this category came from Trench C (11 pieces), while Trench A yielded two pieces and Trench B five sherds with grooved decoration.

Grooved decoration is typical for the late assemblages of the Körös culture. It occurs among the finds from Dévaványa-Barcéi kishalom (Oravecz 1997, fig. 9. 14, fig. 10. 5), Dévaványa 26-Réhely-dűlő (Ecsedy *et al.* 1982, pl. 2. 3, pl. 3. 8), where it was found in association with a rim sherd from a biconical vessel decorated with knobs on the carination (Ecsedy *et al.* 1982, pl. 5. 7), Dévaványa 13-Kér-sziget (Ecsedy *et al.* 1982, 39, pl. 3. 11) and Tiszaug-Tópart (Kutzián 1944, pl. VI. 14). It is also quite widespread in the pottery of the Szatmár II group/AVK 1, e.g. at Tisza-csege-Homokbánya (Kalicz and Makkay 1972, Abb. 6. 12–13, 15, 17, 19), Kenézlő (Kalicz and Makkay 1972, Abb. 7. 10, Abb. 8. 6), Rétközberencs (Kalicz 1984, 117, Abb. 16. 4, 10), Kőtelek-Huszársarok, Pit 8 (Raczky 1983a, fig. 21. 5) and Tiszavalk-Négyes, Pit 1 (Raczky 1988, fig. 26. 8, fig. 29. 1–10). Comparable grooved decoration can be quoted from sites of the early Transdanubian Linear Pottery culture (further TLP) at Budapest-Aranyhegyi út (Kalicz 1993, fig. 31. 1–3, 6, 16), Medina (Kalicz 1993, fig. 18. 7, 10) and Mernye (Kalicz 1993, fig. 20. 5).

Lattice pattern

Incised lattice patterns were popular decorative motifs in the Körös culture and can be found on the pottery from Ecsegfalva too. The pattern is made up of a bundle of parallel lines intersected by another bundle of parallel lines at an angle of 60–80° *(Fig. 27.46. 1–5, 7, Fig. 27.47. 1)*. A lattice pattern of lines intersecting at right angles is rare *(Fig. 27.46. 6)*. Patterns of irregular lines also occur *(Fig. 27.46. 8)*. The lines can be wide and deeply incised *(Fig. 27.46. 3–4)* or shallow, lightly incised ones *(Fig. 27.46. 1, 6–8, Fig. 27.47. 1)*. This pattern usually adorns the vessel body, although it sometimes appears on bases too *(Fig. 27.47. 1)*.

Fragments decorated with a lattice pattern account for 0.86 per cent of the restored pottery from Trench B, and thus the number of pottery sherds decorated in this manner is rather low in most sub-levels *(Table 27.8* and *Fig. 27.38)*. The statistics for this ornamental element are thus hardly representative. Most of the pottery fragments decorated in this manner come from the topsoil and the upper occupation level, although there are significant divergences in the frequency percentages for individual sub-levels compared to the general pottery frequencies. Sherds bearing this patterns have frequencies above the average in sub-levels 1.1, 2.1 and 3.1 and are well below the overall pottery frequency percentages in sub-levels 2.2, 3.2 and 3.4. Regardless of these variations, this decoration can be noted during the entire sequence at Ecsegfalva. The distribution of this pattern in the sequence has no relevance for the internal chronology of the Ecsegfalva site.

Incised linear patterns

The ceramic assemblage included sherds bearing incised linear patterns *(Fig. 27.47. 2–6, Fig. 27.48. 1–8)*. Most of these are slightly curved lines starting from under the rim *(Fig. 27.47. 3–5)*, which probably extended to the vessel's thickened base *(Fig. 27.48. 3–4)*. In some cases, the incised lines cover the entire surface. Sometimes, the lines do not run quite parallel *(Fig. 27.47.*

Table 27.8. Distribution of lattice patterns in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Lattice pattern	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	21	28.76
2.upper occupation level	2.1	1518	17.82	17	23.29
	2.2	912	10.71	2	2.74
	2.3	1774	20.83	9	12.33
3. occupation levels over contexts 390/394/395	3.1	422	4.95	7	9.59
	3.2	597	7.01	2	2.74
	3.3	368	4.32	2	2.74
	3.4	232	2.72	0	0
4. pit fill	4.1	1196	14.04	12	16.44
5. basal levels and pits	5.1	147	1.73	1	1.37
Without stratigraphic context		101	1.19	0	0
Total		**8517**	**100**	**73**	**100**

5–6). On some sherds, the pattern is made up of pairs of parallel *(Fig. 27.48. 5)* or wavy pairs of lines *(Fig. 27.48. 7).* A herringbone-like pattern also occurs *(Fig. 27.48. 8).*

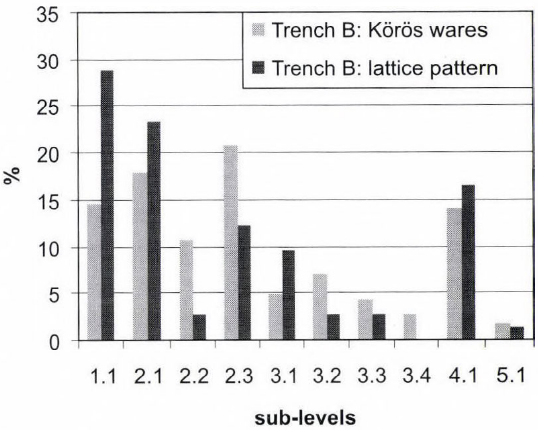


Fig. 27.38. Distribution of lattice patterns in the Körös assemblage from Ecsegfalva 23, Trench B

Initially, pottery fragments bearing a single incised line or a pair of lines or an incised bundle of lines were treated as a separate category. Later, motifs made up of a single line and of several lines were regarded as one statistical category because it was impossible to determine whether a line on a smaller sherd was part of a pattern made up of several lines. As it turned out, no more than 26 fragments (0.31 per cent of the Körös pottery from Trench B) could be assigned to the group of incised pairs of lines, and the distribution of these sherds was uneven, meaning that there was no point in treating this group as a separate statistical category. The distribution of fragments with one or more incised lines is shown in *Table 27.9* and *Fig. 27.39.*

The distribution frequencies of pottery decorated with incised lines in the sub-levels of Trench B differ from the general distribution pattern of Körös sherds. Similarly to the distribution of pottery adorned with a lattice pattern, sherds bearing incised lines are strongly over-represented in the topsoil (sub-level 1.1) and in the uppermost sub-level of the upper occupation level (sub-level 2.1) since about one-half of the pottery fragments in this category was recovered from these two sub-levels. With the exception of two other sub-levels (3.4 and 5.1), the frequency of sherds decorated with incised lines is well below the general frequency of Early Neolithic pottery. Their frequency in the pit fill (sub-level 4.1) more or less corresponds to the frequency of pottery in this level. It must also be noted that sherds with incised lines occur in all sub-levels. The 130 pottery fragments with incised lines account for 1.53 per cent of the Early Neolithic ceramic material from Trench B.

Pottery decorated with obliquely incised lines and bundles of lines can be quoted from the Körös sites at Dévaványa 157-Vágás-part (Ecsedy *et al.* 1982, pl. 2. 1), Dévaványa 78-Sima-

Table 27.9. Distribution of incised linear patterns in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Incised linear patterns	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	33	25.38
2. upper occupation level	2.1	1518	17.82	32	24.62
	2.2	912	10.71	6	4.61
	2.3	1774	20.83	19	14.61
3. occupation levels over contexts 390/394/395	3.1	422	4.95	6	4.61
	3.2	597	7.01	3	2.31
	3.3	368	4.32	3	2.31
	3.4	232	2.72	5	3.85
4. pit fill	4.1	1196	14.04	15	11.54
5. basal levels and pits	5.1	147	1.73	3	2.31
Without stratigraphic context		101	1.19	5	3.85
Total		**8517**	**100**	**130**	**100**

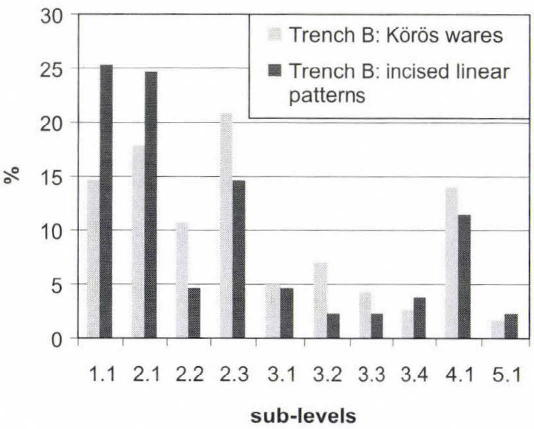


Fig. 27.39. Distribution of incised linear patterns in the Körös assemblage from Ecsegfalva 23, Trench B

sziget (Ecsedy *et al.* 1982, pl. 3. 3) and Vésztő 129-Bálványos-ér (Ecsedy *et al.* 1982, pl. 3. 4), as well as from Gyoma-Csudabala (Kutzián 1944, pl. XI. 12) and Kunszentmárton-Nagyérpart (Kutzián 1944, pl. XIX. 3). Obliquely curved lines adorn a vessel brought to light at Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XXVIII. 5) and pairs of such lines were used to decorate a pot from Tiszaug-Tópart (Kutzián 1944, pl. VI. 11). Pottery fragments decorated with incised bundles of lines (Raczky 1976, fig. 13. 6) and pairs of lines (Raczky 1976, fig. 4. 5) have been published from Tiszajenő-Szárazérpart, where the incised pairs of lines on some of the fragments may have formed a loose lattice pattern (Raczky 1976, fig. 9. 5, fig. 12. 7). A rim sherd with an angular line is known from Körösladány 83-Siskási-dűlő (Ecsedy *et al.* 1982, pl. 3. 5). The incised linear patterns of the Körös culture differ from those of the AVK. The incised lines were coarser and rather uneven on Early Neolithic pottery and the edges of the incisions were not smoothed.

Stroke-burnished decoration

A stroke-burnished pattern was noted in two cases among the finds from Ecsegfalva (both from Trench B). A flattened globular vessel probably set on four small feet was assembled and restored from its fragments. The vessel body was covered with a fine stroke-burnished pattern. The panels created by the long stroke-burnished lines were filled with intersecting or parallel lines. The vessel was lightly polished, but it became worn to such an extent that even the stroke-burnished pattern wore off in some spots. It seems likely that the polishing was much stronger originally *(Fig. 27.24. 2a–c, Fig. 27.49. 2a–d)*. The other pottery fragment is also decorated with stroke-burnishing. The carefully polished, dark grey vessel fragment tempered with chaff and sand bears a zig-zag pattern made using this technique *(Fig. 27.49. 1)*.

Raczky argued that stroke-burnished patterns are diagnostic for late Körös assemblages (Raczky 1988, 28), while Makkay claimed that this decorative technique is specific to the Protovinča type (Makkay 1990b, 114, type B6). In his opinion, various types of burnished and impressed patterns had appeared as early as the earliest Körös phase, with the exception of channelling (Makkay 2000, 312).

Appliqué decoration

Ribs
Coming in a variety of forms, ribs were often decorated with various types of impressions. Impressed decoration could be by fingertip *(Fig. 27.26. 4–5, Fig. 27.50. 2–3)* or nail *(Fig. 27.50. 1)*, although fragments bearing ribs impressed with a twig have also been found *(Fig. 27.50. 4)*. Some curved ribs are undecorated *(Fig. 27.50. 6)*. Some of these ribs may have been part of a goat *(Fig. 27.51. 1)* or a deer figure *(Fig. 27.51. 2)*, although this is uncertain owing to their fragmentary state. Pottery sherds from thin-walled, fine pottery tempered with chaff and sand are sometimes decorated with a rib type, which differs from the above. Most of these ribs are straight or curved, undecorated and have carefully smoothed edges *(Fig. 27.50. 5, 7–8)*.

Knobs
Various types of knobs can be distinguished in the ceramic assemblage. Oval knobs, usually set on the carination of biconical vessels *(Fig. 27.14. 2, Fig. 27.30. 5, Fig. 27.16. 2–6, Fig. 27.17. 1–2)* and, more rarely, of pots with a cylindrical upper part *(Fig. 27.13. 1, Fig. 27.30. 2)*, appear to have been quite popular. Barbotine-like knobs are usually finger-impressed *(Fig. 27.51. 3–4)*, similarly to flat disc-shaped knobs *(Fig. 27.51. 5–6)*. Some vessels are decorated with slightly pointed knobs set on the carination *(Fig. 27.51. 7)*. Double knobs have a more rounded *(Fig. 27.51. 8, Fig. 27.52. 1)* and a pointed, conical variant *(Fig. 27.52. 2)*. Larger, coarse knobs are sometimes divided by finger-drawn vertical lines *(Fig. 27.52. 3–4)*, while elongated oval knobs are often segmented into three with finger impressions *(Fig. 27.52. 5–7)*. Knobs divided into two or more parts by vertical grooving also occur among the finds *(Fig. 27.52. 8–9)*.

Applied barbotine
Prehistorians studying the Körös culture distinguish different types of barbotine: applied barbotine, *Schlickwurf* barbotine[10] and channelled barbotine. This has been the source of many misunderstandings because, as Makkay has aptly noted, very often differing and wholly unrelated ornamental techniques have been lumped together under the label barbotine (Makkay 1969, 24). Applied barbotine is made up of irregular blobs of clay set on a vessel. The distribution of applied barbotine *(Fig. 27.53. 1–6)* in Trench B is shown in *Table 27.10* and *Fig. 27.40*.

Table 27.10 and *Fig. 27.40* indicate that applied barbotine occurs in all sub-levels, with the exception of sub-level 5.1. Similarly to the Early Neolithic assemblage and the distribution of other ornamental elements, the finds are concentrated in the topsoil (sub-level 1.1) and in the sub-levels of the upper occupation level. The distribution in the various sub-levels appears to be quite random. The lower than average frequency in the pit fill (sub-level 4.1) is striking. A total of 172 joined pottery sherds with applied barbotine decoration could be distinguished, accounting for 2.02 per cent of the pottery finds.

Trogmayer tried to determine the internal chronology of the Körös culture from the frequency of barbotine decoration. From his study of the pottery assemblages excavated at four sites in the southern part of the Great Hungarian Plain, he concluded that this ornamental mode was virtually

Table 27.10. Distribution of applied barbotine decoration in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Applied barbotine	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	18	10.46
2. upper occupation level	2.1	1518	17.82	26	15.12
	2.2	912	10.71	33	19.19
	2.3	1774	20.83	51	29.65
3. occupation levels over contexts 390/394/395	3.1	422	4.95	14	8.14
	3.2	597	7.01	9	5.23
	3.3	368	4.32	4	2.33
	3.4	232	2.72	2	1.16
4. pit fill	4.1	1196	14.04	12	6.98
5. basal levels and pits	5.1	147	1.73	0	0
Without stratigraphic context		101	1.19	3	1.74
Total		**8517**	**100**	**172**	**100**

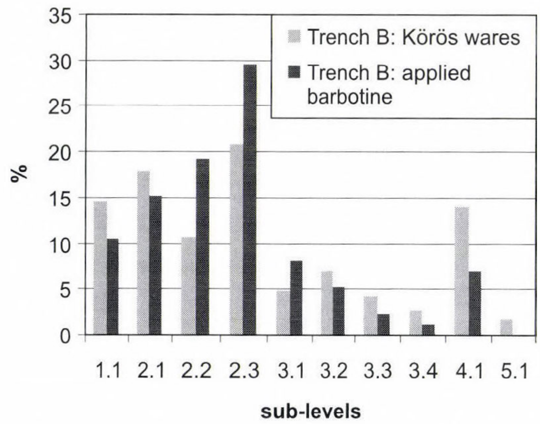


Fig. 27.40. Distribution of applied barbotine decoration in the Körös assemblage from Ecsegfalva 23, Trench B

unknown in the early Körös period and that the frequency of barbotine decorated wares increased during the culture's life-span (Trogmayer 1968b, 11, fig. 1). Even though Trogmayer distinguished various types of barbotine decoration in the pottery assemblage recovered from Pit 3 at Maroslele-Pana (Trogmayer 1964, 70; 1968b, 9), the different barbotine decorations are lumped into a single category in his statistical tables (Trogmayer 1968b, 9–10).

Schlickwurf barbotine

The other ornamental technique described as barbotine is the so-called *Schlickwurf* technique. However, this label often covers two different decorative techniques in Hungarian archaeological literature: *Schlickwurf* barbotine proper and finger-drawn or channelled barbotine. The ceramic object was splashed with semi-liquid clay paste in both cases, which was smoothed in the case of channelled barbotine, creating a pattern resembling channelling. Channelled barbotine does not occur among the finds from Ecsegfalva; *Schlickwurf* barbotine decoration was noted on six pottery fragments from Trench B *(Fig. 27.54. 1–5, 7)* and on one from Trench C *(Fig. 27.54. 6)*. The fragments in Trench B came from sub-levels 2.1, 2.2 and 2.3. The proportion of sherds decorated with *Schlickwurf* barbotine does not amount to one thousandth of the pottery assemblage and it must also be noted that about one-half of all the pottery came from these three sub-levels.

According to Trogmayer, applied barbotine accounted for 5.5 per cent, and *Schlickwurf* barbotine for 5.6 per cent among the finds from Pit 3 at Maroslele-Pana (Trogmayer 1964, 70; 1968b, 9). The proportion of genuine *Schlickwurf* and channelled barbotine among the fragments which he assigned to the *Schlickwurf* category remains unknown. The published finds include one sherd with channelled barbotine (Trogmayer 1964, fig. 7. 3). Pottery decorated with *Schlickwurf* barbotine was recovered from Pit 7 at the Deszk-Olajkút 1 site (Trogmayer 1968d, pl. XLIII. 5), wares with channelled barbotine from Pit 15 of the same site (Trogmayer 1968d, pl. XLVI. 1, 3). Pit 15 can be assigned to the latest Körös phase both on typological grounds (Trogmayer 1968b, 8, 11, fig. 1), and in the light of the radiocarbon dates (Quitta and Kohl 1969, 240). Seven pottery sherds described as being *Schlickwurf* barbotine decorated were brought to light at Tiszajenő-Szárazérpart (Raczky 1976, 186), which represent a negligible amount in the assemblage made up of 2174 ceramic fragments. Two published fragments can be assigned to the *Schlickwurf* category, rather than to channelled barbotine (Raczky 1976, fig. 12. 4, 8). The 245 pottery sherds recovered from a Körös pit excavated at Kőtelek-Huszársarok (Pit 1) contained sixteen fragments decorated with applied (classical) barbotine, while one fragment was described as bearing *Schlickwurf* barbotine.[11] Raczky dated the pit to the period preceding the so-called Protovinča phase based on the proportion of Schlickwurf and biconical vessel fragments. In his view, the finds pre-dated the assemblage from Maroslele-Pana, Pit 3, and post-dated the assemblage from Röszke-Lúdvár, Pit 1 (Raczky 1983b, 162, fig. 4, 166). He assigned the finds from Pit 8 of the Kőtelek-Huszársarok site to the Szatmár II group/AVK 1. In addition to two or three sherds decorated with applied (classical) barbotine (Raczky 1983b, 181, fig. 11, fig. 19. 1), the assemblage of 1313 pottery sherds included 111 Schlickwurf decorated fragments (Raczky 1976, 186; Raczky 1983b, 181, fig. 19. 5, fig. 21. 1–2, 6, fig. 23. 1, 3–7, fig. 24. 10–11). In his publication, the label *Schlickwurf* is used to describe both *Schlickwurf* and channelled barbotine.

Raczky and Kalicz argued that *Schlickwurf* barbotine[12] can be linked to the late Körös assemblages and the transition between the Early and the Middle Neolithic (Raczky 1976, 186; 1983b, 181, 191; Kalicz 1980b, 24). Horváth pointed out that in addition to chronological differences, regional variations can also be noted since channelled barbotine decoration is absent from the Körös assemblages of the Middle Tisza region, but occurs on sites in the Maros region (Horváth 1996, 128). Kalicz regarded the widespread use of channelled barbotine in the Transdanubian Starčevo culture and its rarity in Körös assemblages as one of the principal differences between the two cultures (Kalicz 1990, 85; 2000, 298).

In her analysis of the ceramic inventory from the Starčevo site at Babarc in Transdanubia, Eszter Bánffy drew a clear distinction between *Schlickwurf* (Bánffy 2001, 45, Taf. 1. 4, Taf. 2. 11; Taf. 3. 14, Taf. 5. 9) and channelled barbotine (Bánffy 2001, 45, Taf. 2. 1–4, 8–9, 12, Taf. 3. 1, 3, 6, Taf. 4. 5–7, 9–12, Taf. 5. 10, Taf. 6. 1–2, 6, 8, 10). Channelled barbotine is undeniably quite popular in the Early Neolithic assemblages from Transdanubia, as shown by the ceramic inventory from Becsehely I-Bükkaljai-dűlő (Kalicz 1993, fig. 11. 1), Dombóvár-Kapospart[13] (Kalicz 1990, Taf. 41. 5, Taf. 42. 1, 9, Taf. 44. 2, 6, 10–11; Kalicz 1993, fig. 11. 2, 6, 10–11), Harc-Nyanyapuszta (Kalicz 1990, Taf. 44. 5; Kalicz 1993, fig. 11. 5), Kaposvár-Deseda (Kalicz 1990, Taf. 35. 6–12, Taf. 36. 2, 4, 6–7, Taf. 37. 3–4, 6–7; Kalicz 1993, fig. 13. 2, 4, 6–7) and Lánycsók-Bácsfa puszta (Kalicz 1990, Taf. 19. 1–2, 7–8; Kalicz 1993, fig. 8. 1–2, 7–8). It has been reported from Gellénháza-Városrét (Simon 1996, 79, Abb. 7. 2–3) and Vörs-Máriaasszony-sziget (Kalicz *et al.* 1998, fig. 6b. 4, fig. 9b. 9–10, 15–16). Channelled barbotine decoration survived into the first half of the Middle Neolithic in Transdanubia, occurring among the finds of the earliest (formative) TLP phase at Szentgyörgyvölgy-Pityerdomb (Bánffy 2004, fig. 98. 3). It is particularly frequent in the early Linear Pottery assemblage from Budapest-Aranyhegyi út (Kalicz 1993, fig. 33. 1–3, 6–7, fig. 34. 1–2, 5–9, 11, 14), and sherds decorated in this manner have also been found among the finds dating to the early TLP phase from Baja (Kalicz 1993, fig. 26. 8), Barcs (Kalicz 1993, fig. 22. 15, fig. 23. 4), Révfülöp (Kalicz 1980, Taf. 8. 3–4, 11–12; Kalicz 1993, fig. 19. 7–8, 11–12), Vonyarcvashegy (Kalicz 1980b, Taf. 9. 6, 9) and Zalavár (Kalicz 1980b, Taf. 10. 11).

Channelled barbotine was one of the many decorative techniques of the latest Körös phase in the southern part of the Great Hungarian Plain and in the Szatmár II group/AVK 1. It was a typical feature of the transition from the Early to the Middle Neolithic both in eastern Hungary and in Transdanubia (although more common in the latter region). In contrast, it is uncertain whether *Schlickwurf* barbotine has a similar role as a chronological indicator.

Polishing

Fragments of polished vessels were also brought to light at Ecsegfalva *(Fig. 27.31. 1, 4, Fig. 27.49. 1–2, Fig. 27.55. 1–6)*. Their surface is in many cases very worn and thus the remains of polishing could only be detected with difficulty. It seems reasonable to assume that the polish had completely worn off on a number of surviving pottery sherds. Even though we recorded every fragment with a polished surface during the study of the ceramic finds, it would have been pointless and misleading to draw any conclusions from this by necessity incomplete record concerning the frequency of polished vessels in various levels. Polished vessels were tempered with chaff and sand, and most were fired to a dark grey, greyish-brown or black colour. Some of the polished fragments came from a globular vessel with a short neck and everted rim or a globular or S-profiled vessel, but in most cases, it was impossible to determine what type of vessel the sherd came from.

Slip

The ceramic assemblage did not contain any pottery fragments decorated with painted patterns, but it did include vessels covered with a slip *(Fig. 27.56. 1–6)*. Eight joined pottery fragments covered with a brown, red or reddish-brown slip were identified; two came from Trench A, six from Trench B. One of the slip-covered pottery fragments from Trench B is actually joined from two sherds. This decoration was chiefly applied to thin-walled fine wares, although it sometimes occurs on thick-walled vessels too. It can be noted on the exterior and interior vessel surface, often on both. Many of these sherds are worn and the worn surfaces can be easily mistaken for painting. Slipped vessel fragments were recovered from sub-levels 2.2 and 4.3 in Trench A, and from sub-levels 2.3, 3.2, 3.3 and 4.1 in Trench B. These pottery sherds can be found in various sub-levels of the stratigraphic sequence. In spite of their small number, we may say that they are generally characteristic of the pottery assemblage brought to light at the Ecsegfalva 23 site. Slip decorated vessels were common in the Körös culture (Makkay and Trogmayer 1966, 47).

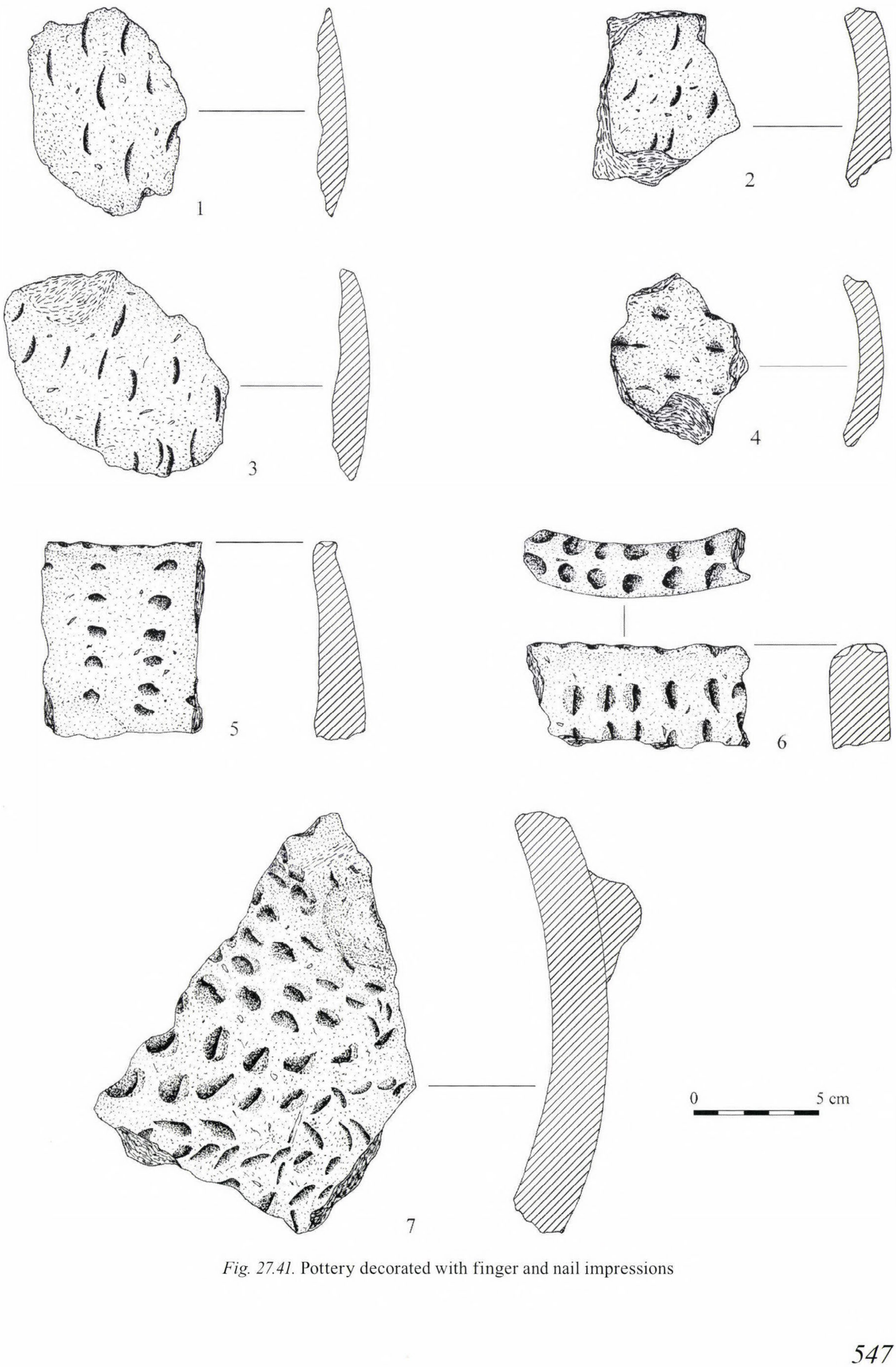


Fig. 27.41. Pottery decorated with finger and nail impressions

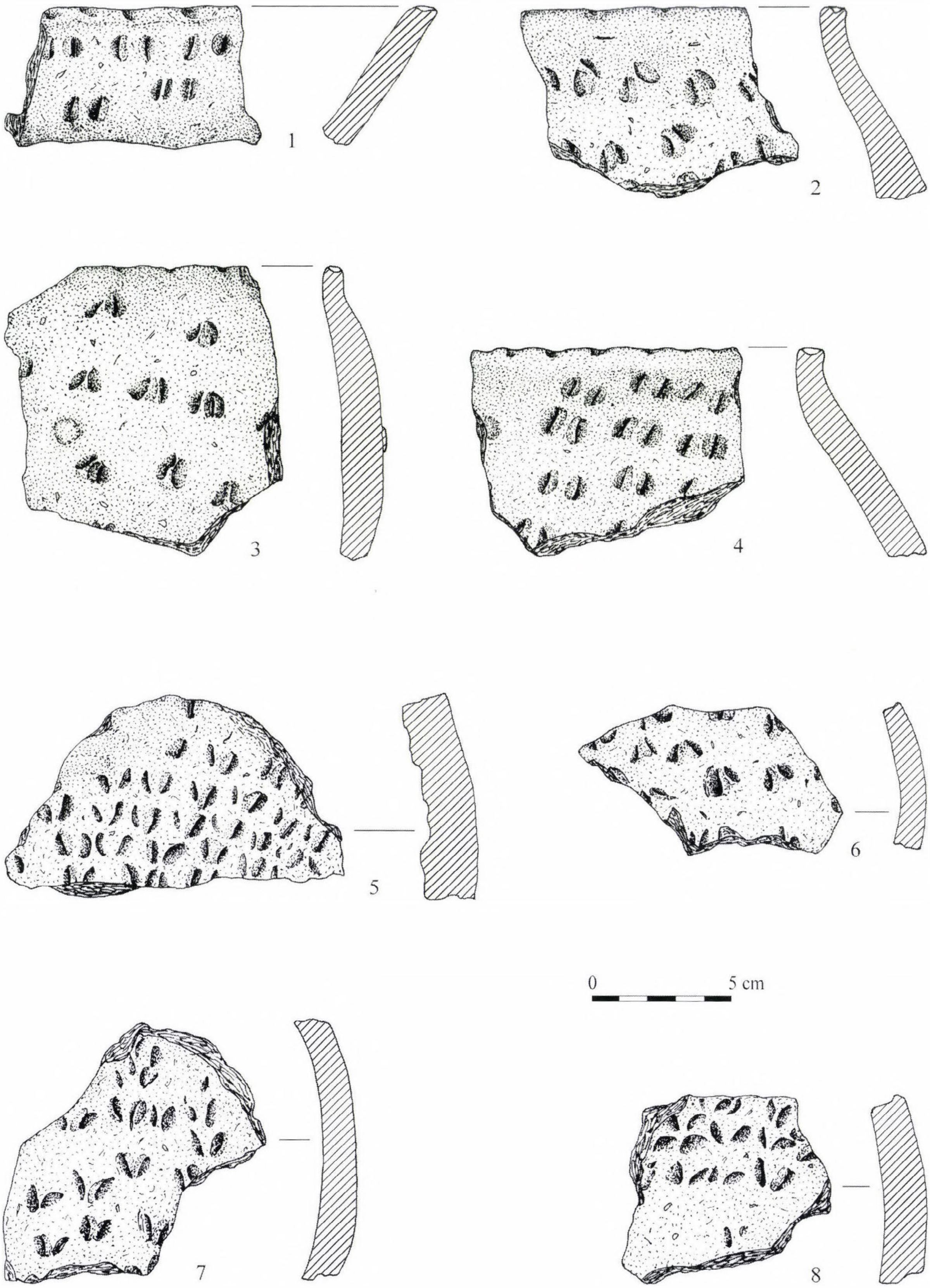


Fig. 27.42. Pottery with pinched decoration

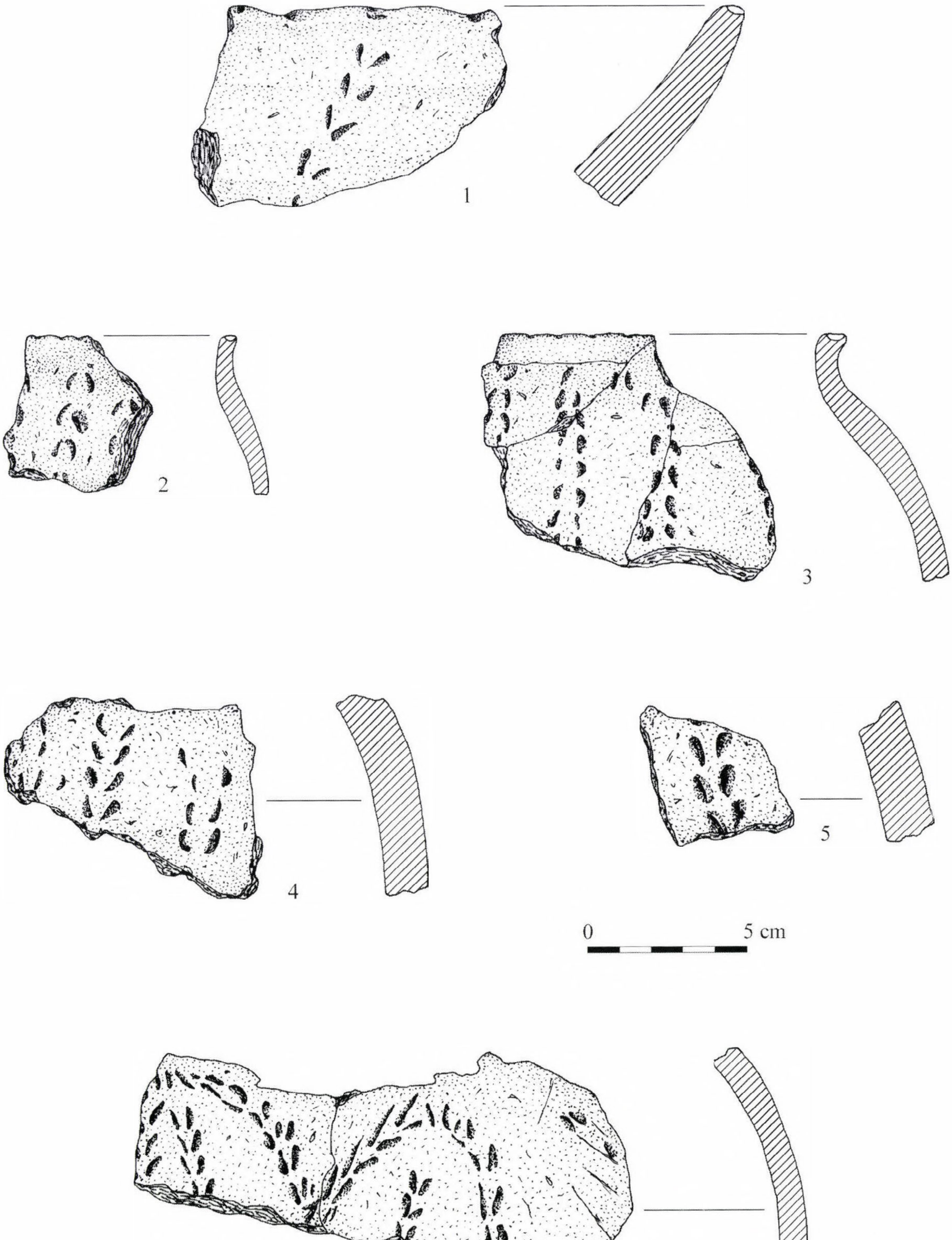


Fig. 27.43. Pottery with spike motif decoration

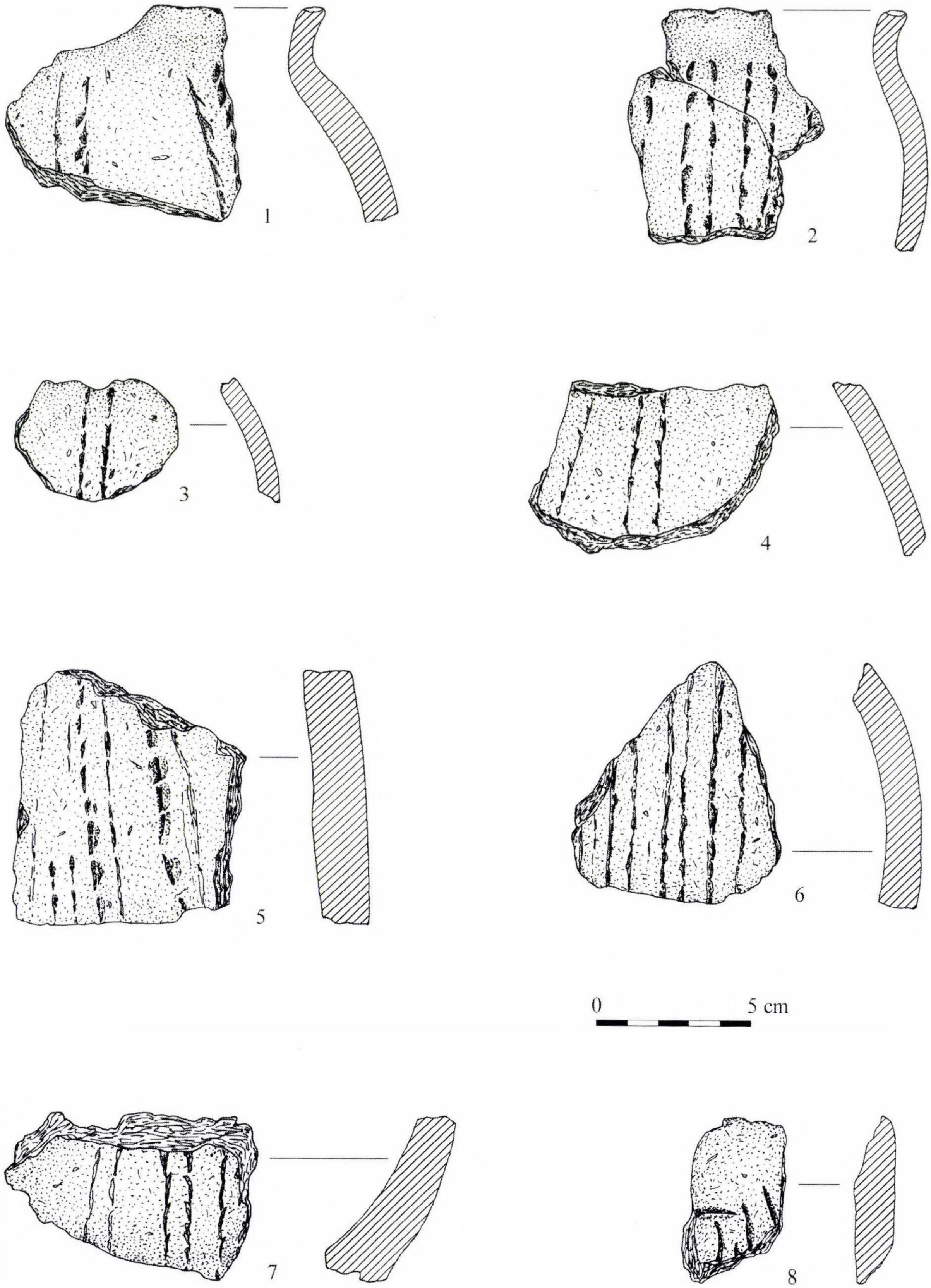


Fig. 27.44. Pottery with spike motifs arranged into rows and mussel impressions

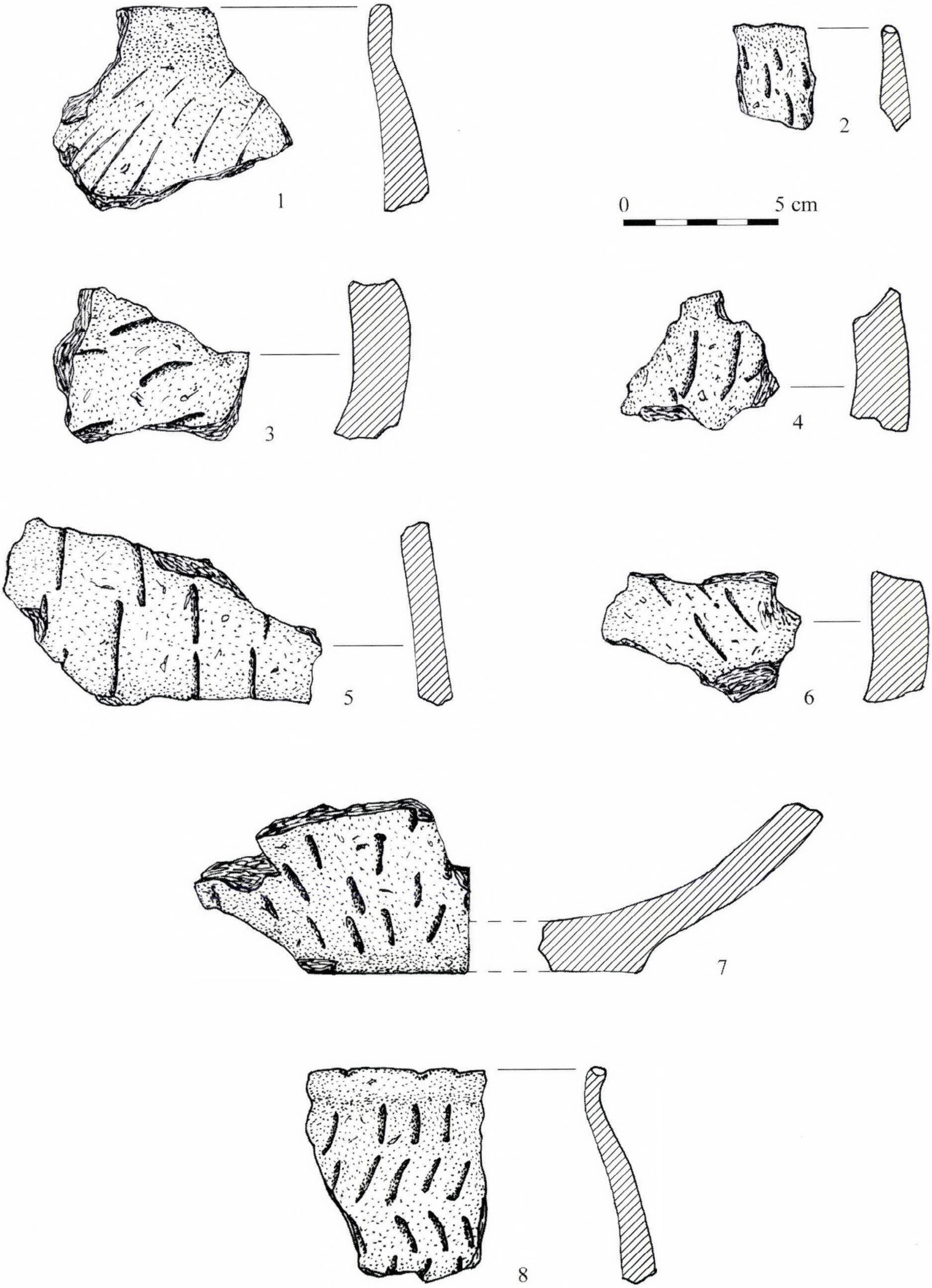


Fig. 27.45. Pottery with grooved decoration

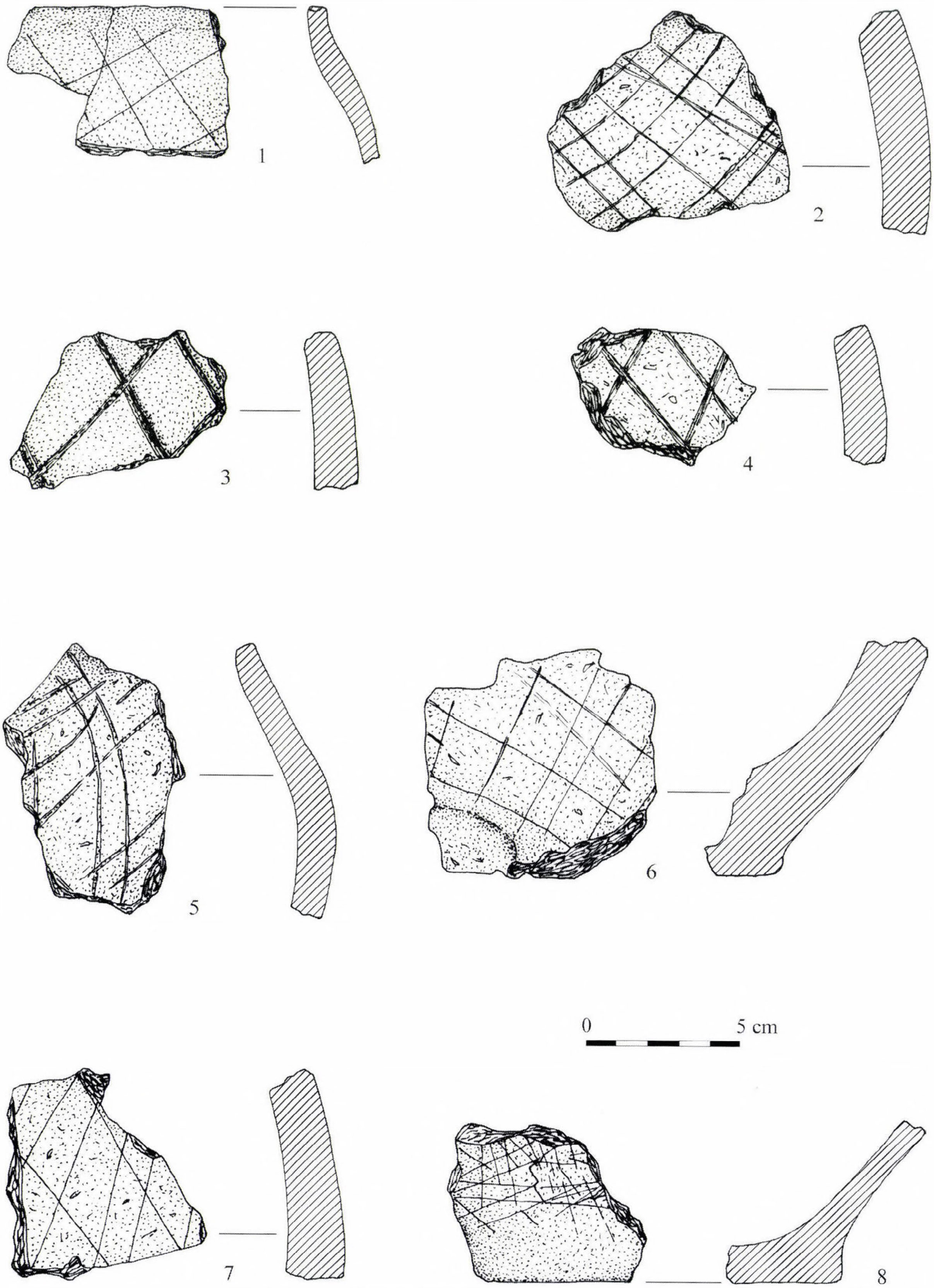


Fig. 27.46. Pottery decorated with lattice patterns

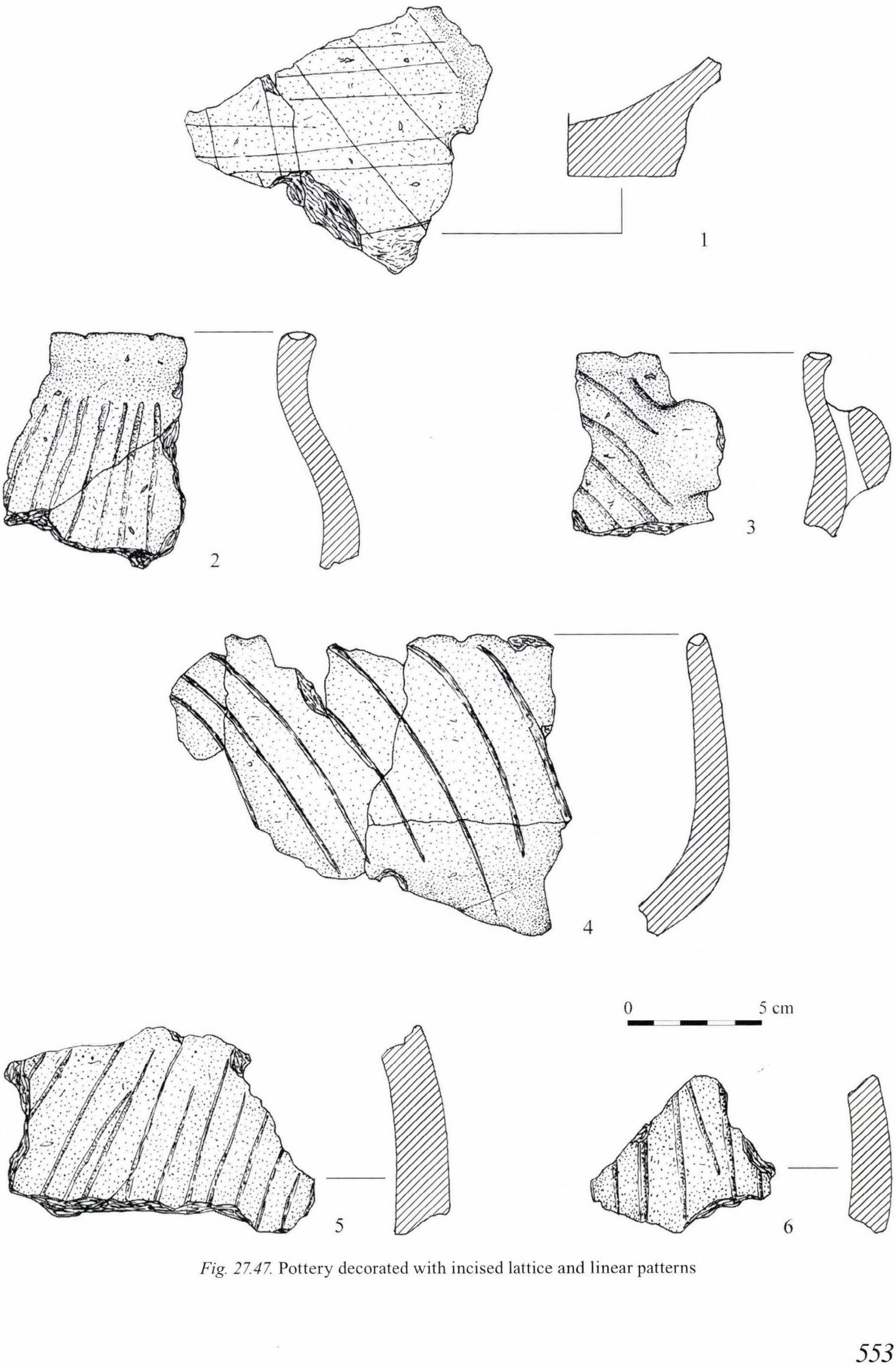


Fig. 27.47. Pottery decorated with incised lattice and linear patterns

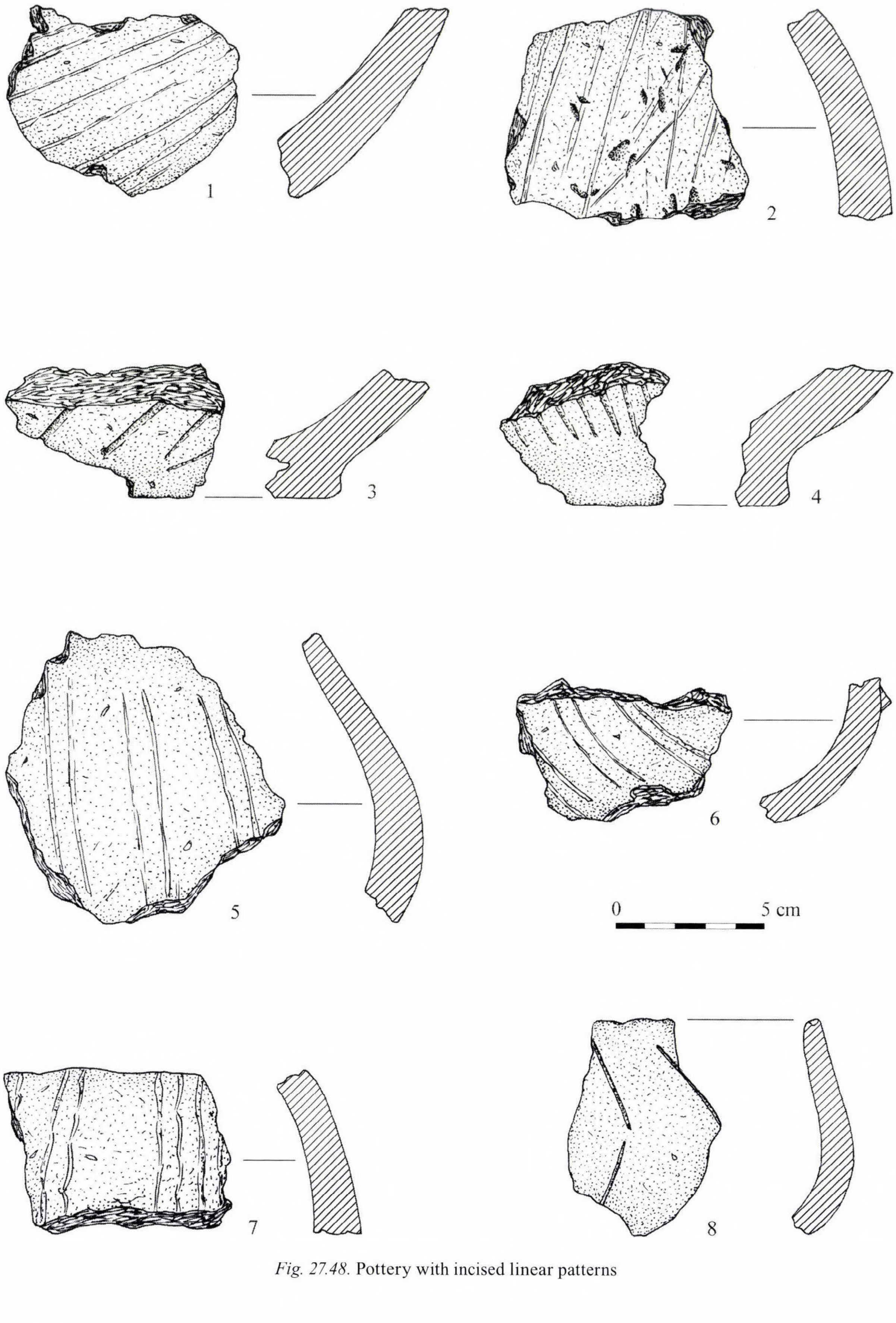


Fig. 27.48. Pottery with incised linear patterns

1

0 5 cm

2a

2b

0 10 cm

2c

2d

Fig. 27.49. Pottery decorated with stroke-burnished patterns

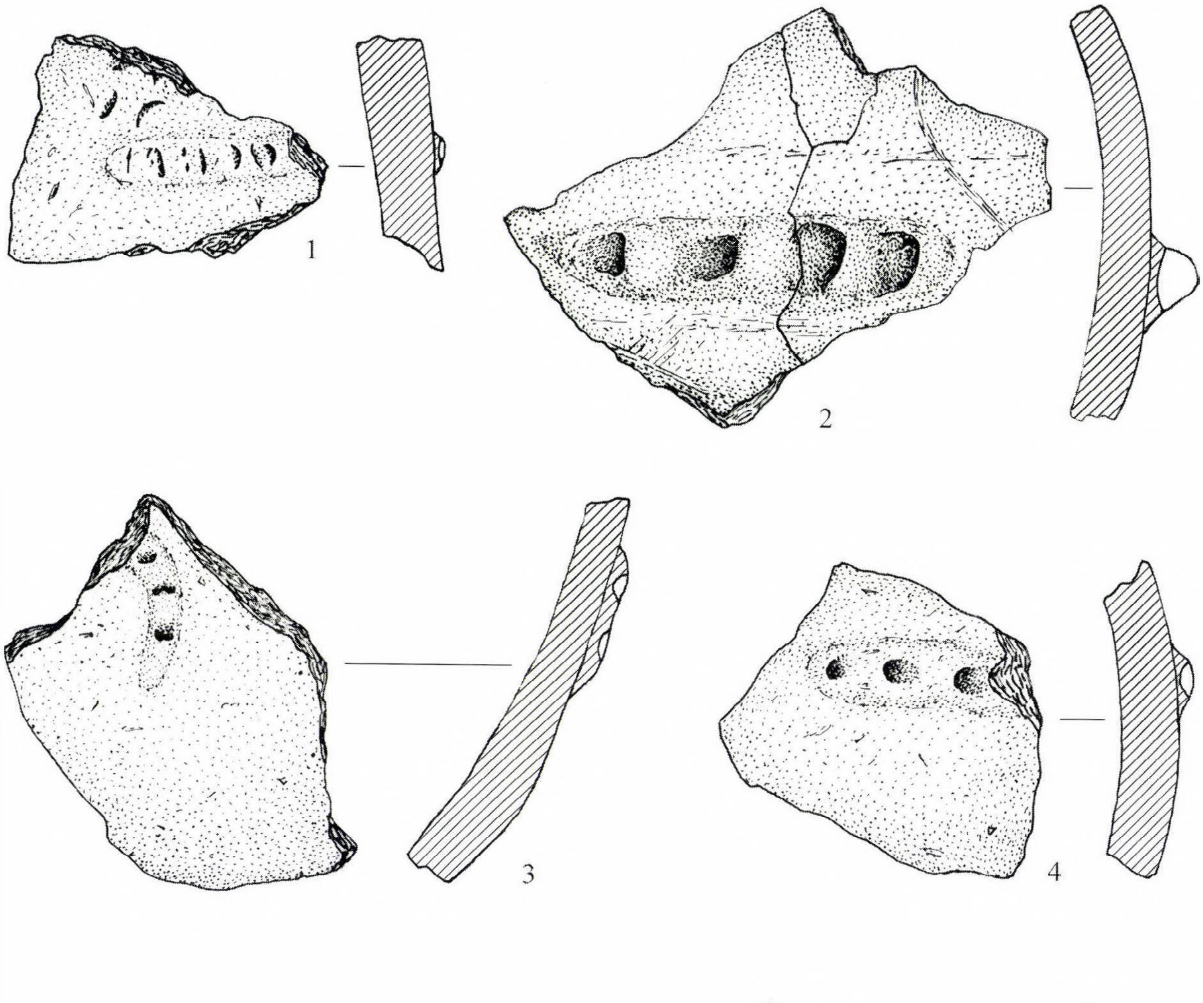


Fig. 27.50. Pottery decorated with ribs

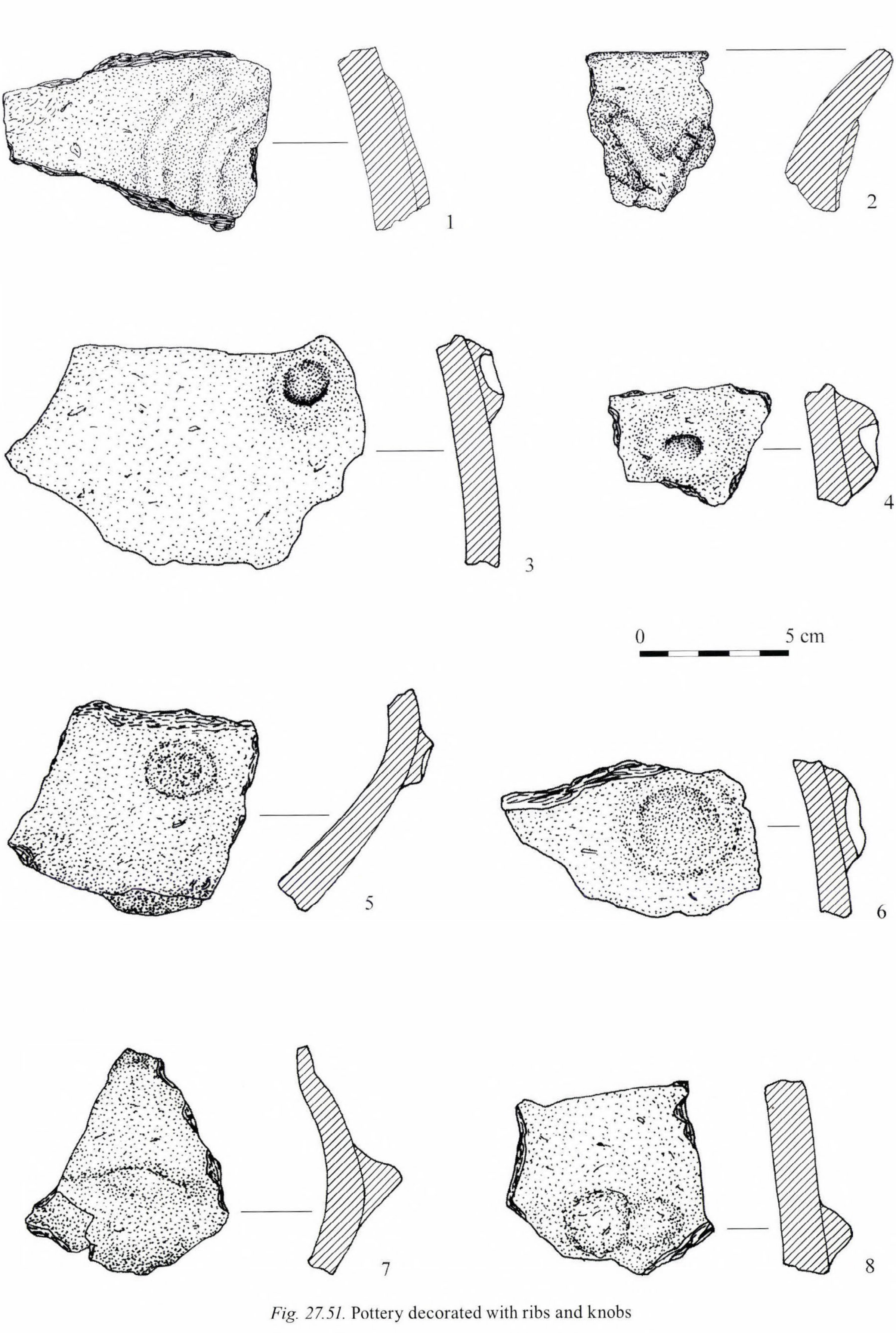


Fig. 27.51. Pottery decorated with ribs and knobs

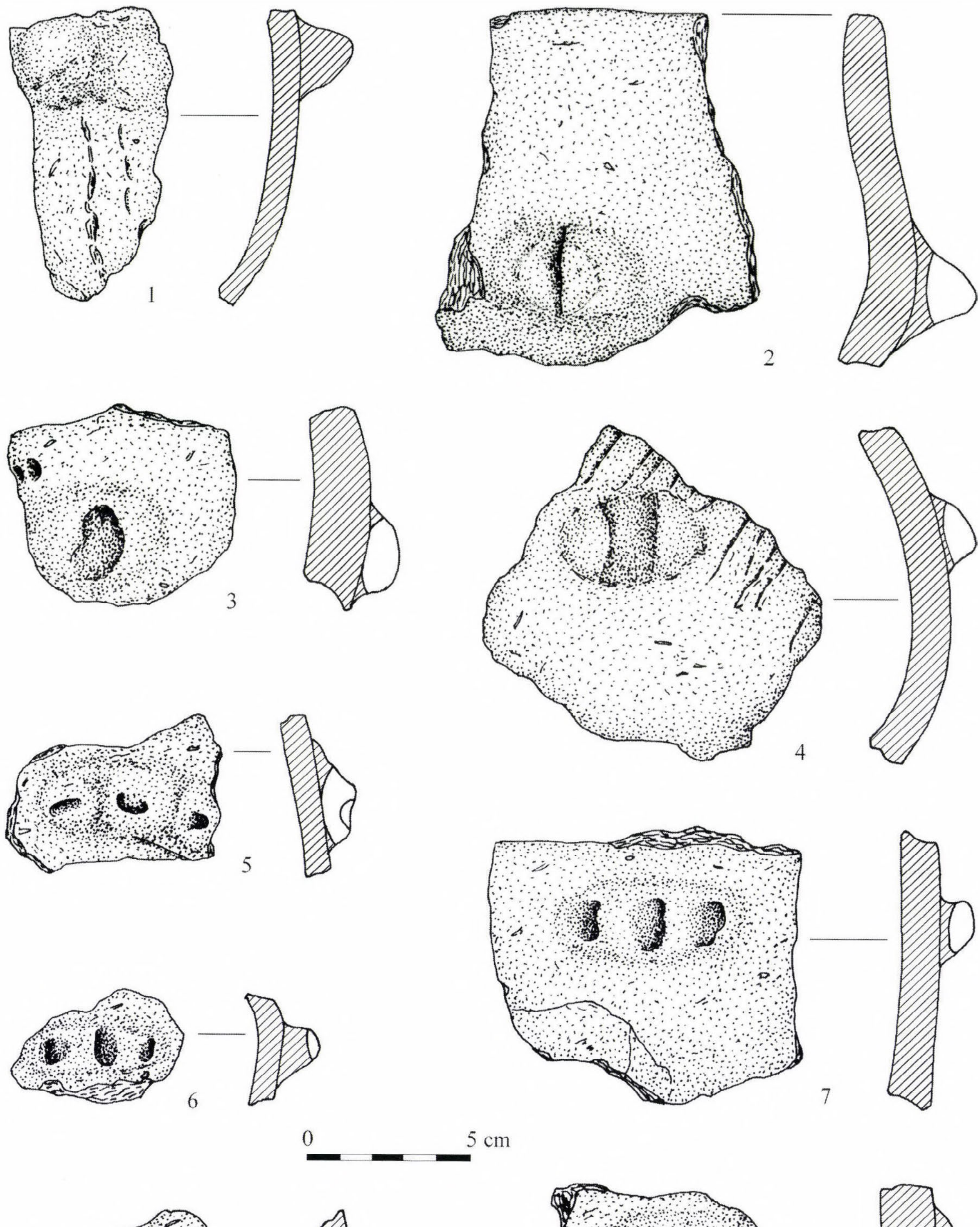


Fig. 27.52. Pottery decorated with knobs

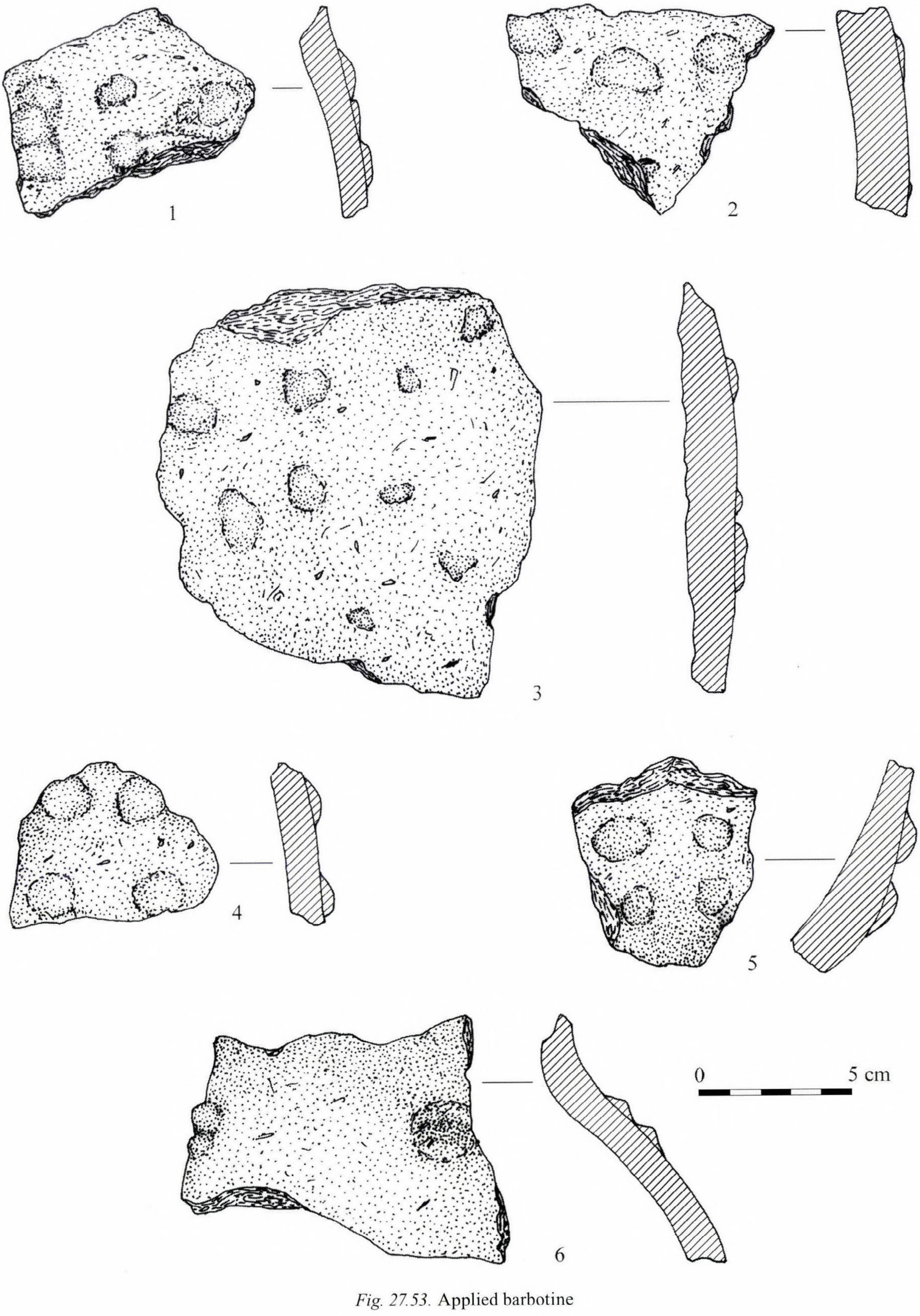


Fig. 27.53. Applied barbotine

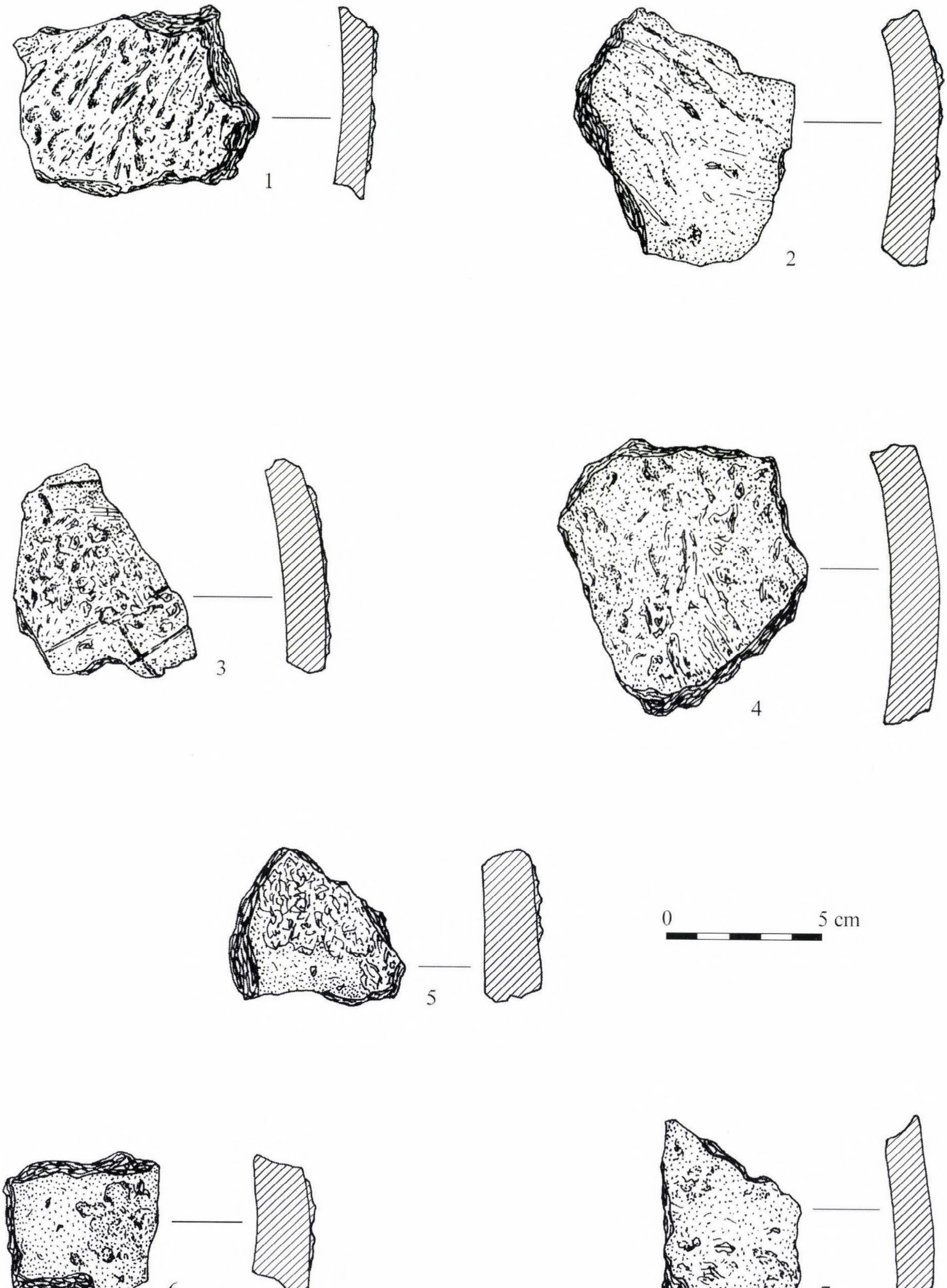


Fig. 27.54. Pottery decorated with *Schlickwurf* barbotine

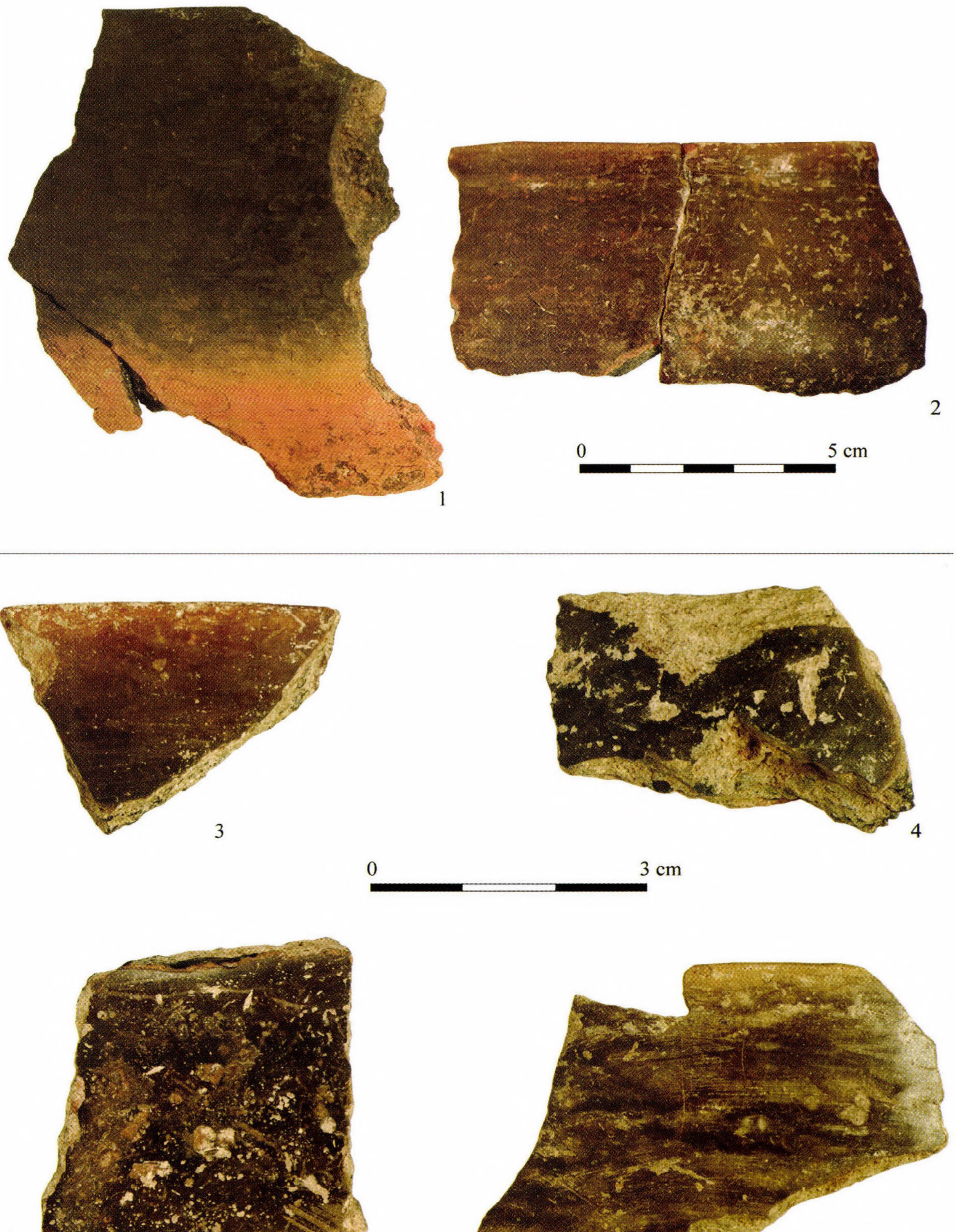


Fig. 27.55. Polished pottery

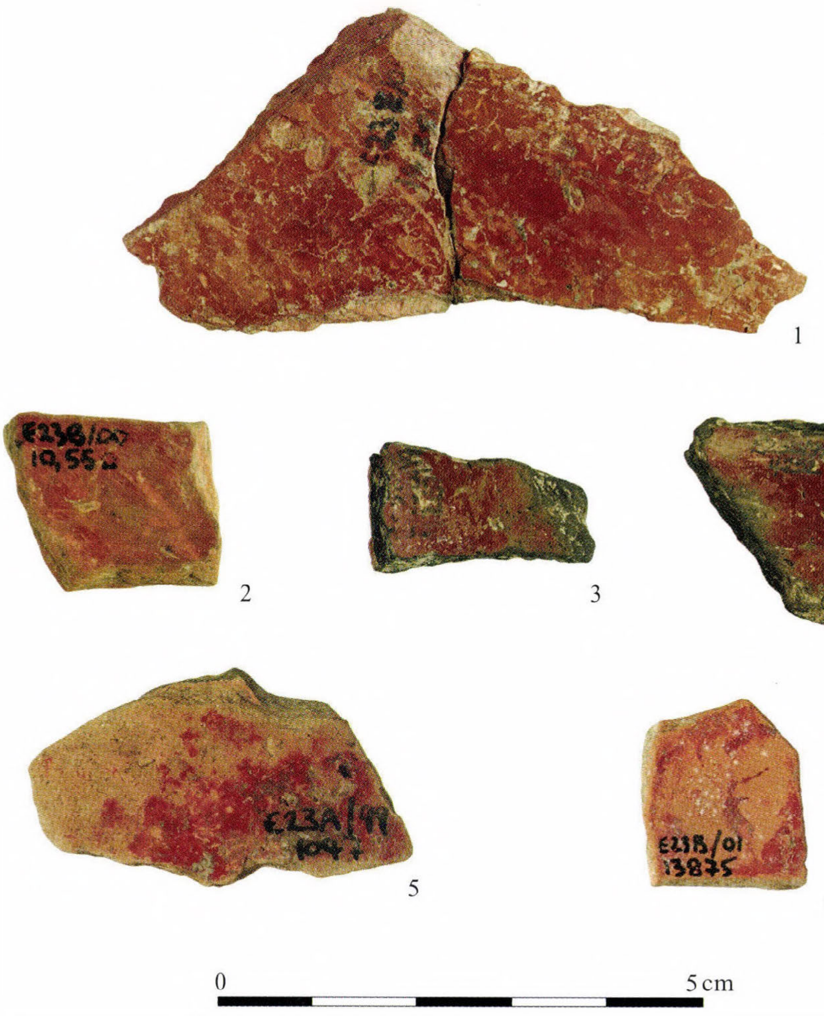


Fig. 27.56. Slip-covered pottery

Carinated vessels

Carinated vessels in the Ecsegfalva ceramic inventory

Most of the pottery fragments in this category come from bowls. More closed biconical vessels are also known; a mug of this type was found at Ecsegfalva 23 too *(Fig. 27.21. 1, Fig. 27.31. 4)*. The presence or absence of carinated forms is one of the few chronological anchors for the internal periodisation of the Körös culture. Many Körös assemblages include carinated forms, such as the ones from Dévaványa-Atyaszeg (Makkay 1990b, pl. 3. 2; Oravecz 1995, 63, Abb. 1. 1–7), Dévaványa-Barcéi kishalom (Oravecz 1997, fig. 6. 1–3, 9–10, fig. 8. 1–3, 6–7, 18), Dévaványa-Réhelyi gát (Ecsedy 1973; Goldman 1991), Endrőd 119-Öregszőlők (Makkay 1992, 151, pl. 1. 1–2, 5), Hódmezővásárhely-Laktanya (Paluch 2005, 38, fig. 17. 2), Maroslele-Pana, Pit 3 (Trogmayer 1964, 68, fig. 4. 4, 6, fig. 6. 1, 2, 12, fig. 7. 8), Öcsöd-Kiritó-nyugati part (Raczky 1988, fig. 5. 6–8, fig. 6. 8, fig. 7. 1–10, fig. 8. 1–9), Szarvas 23-Egyházföld, Trench VIII (Makkay 1987, 18, Abb. 1. 14–15, Abb. 3. 6), Szentes-Szentlászló (Makkay 1990b, 117, pl. 3. 1) and Tiszaug-Tópart (Makkay 1990b, 117, pl. 3. 3). The relevance of this vessel type for the periodisation of the Körös culture has been discussed by Makkay in a series of studies (Makkay 1969; 1987; 1990b; 1996). He introduced the widely challenged 'Protovinča' label for describing the cultural context of these vessels (Makkay 1969; 1982b; 1987; 1990b; 1996), which had initially been a chronological concept (Makkay 1969, 25). Makkay regarded the appearance of the earliest Vinča traits in the Körös-Starčevo complex as the single well-definable and separable phase, which he equated with the latest Körös period[14] (Makkay 1969, 25). He later noted that carinated vessels appeared by the so-called classical Körös phase (Makkay 1990b, 113, 121), and he eventually conceded that the finds he had defined as Protovinča types could actually be found in very early Körös-Starčevo assemblages too, which pre-dated the late Körös-Starčevo period (Makkay 1996, 45). Raczky described biconical vessels as a typical find type of the late Körös culture (Raczky 1988, 28).

Distribution of carinated vessels in Trench B

Owing to their role as a chronological anchor, it is instructive to examine the distribution of carinated vessels in the Ecsegfalva sequence for it may shed light on the settlement's internal chronology (*Table 27.11* and *Fig. 27.57*).

Table 27.11. Distribution of carinated vessels in the Körös assemblage from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	Trench B (Körös finds)		Carinated vessels	
		joined	%	joined	%
1. topsoil	1.1	1250	14.68	18	20.23
2. upper occupation level	2.1	1518	17.82	11	12.36
	2.2	912	10.71	16	17.98
	2.3	1774	20.83	17	19.10
3. occupation levels over contexts 390/394/395	3.1	422	4.95	6	6.74
	3.2	597	7.01	3	3.37
	3.3	368	4.32	3	3.37
	3.4	232	2.72	1	1.12
4. pit fill	4.1	1196	14.04	13	14.61
5. basal levels and pits	5.1	147	1.73	1	1.12
Without stratigraphic context		101	1.19	0	0
Total		**8517**	**100**	**89**	**100**

It can be seen that the distribution frequencies form two main clusters. The topsoil (sub-level 1.1), the upper occupation level (sub-levels 2.1, 2.2 and 2.3) and the pit fill (sub-level 4.1) yielded between 10.71 and 20.83 per cent of all the pottery finds and of carinated vessel fragments, while the same percentage ranges between 1.12 and 7.01 per cent in the case of the occupation levels above contexts 390/394/395 (sub-levels 3.1, 3.2, 3.3 and 3.4) and the basal levels (sub-level 5.1). In other words, the upper levels and the pit fill, yielding a rich assortment of finds, differ markedly from the lower layers, which were poorer in finds. Another notable point is that the distribution of carinated vessels corresponds to the overall distribution of Körös

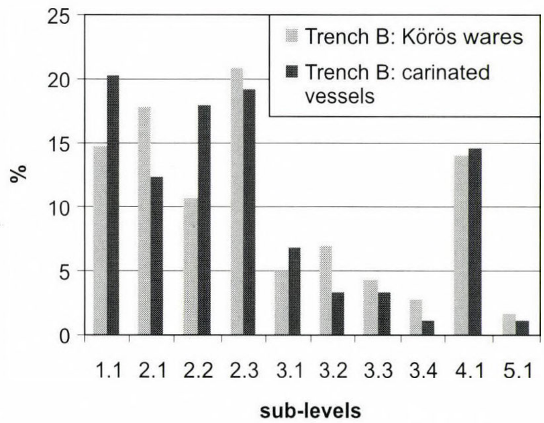


Fig. 27.57. Distribution of carinated vessels in the Körös assemblage from Ecsegfalva 23, Trench B

pottery. The ceramic inventory can be regarded as homogenous in this sense and no sharp breaks can be noted in the proportion of carinated vessels during the settlement's life-span. It must, however, be borne in mind that carinated vessels account for no more than 1.045 per cent of the pottery.

Finds of the Alföld Linear Pottery culture

Overview of the AVK finds

The Middle Neolithic pottery differs fundamentally from the Körös wares excavated at the Ecsegfalva 23 site. AVK pottery is characterised by thin-walled, well-fired vessels tempered with sand. Rim forms range from the rounded *(Fig. 27.59. 2, Fig. 27.60. 3–5)*, to the flat *(Fig. 27.60. 2)* and the thinned *(Fig. 27.60. 1, 6)*. The typical thickened bases of Körös pottery disappear, to be replaced by plain flat bases *(Fig. 27.61. 1a–b, Fig. 27.62. 1–4)*. The finds include a pedestalled vessel decorated with an incised linear pattern *(Fig. 27.61. 2)*, a rectangular handle set on a pronounced vessel shoulder *(Fig. 27.59. 7)*, as well as a vessel spout with notched rim *(Fig. 27.59. 6)*.

Vessels are decorated with various linear patterns. These include straight smoothed-in *(Fig. 27.58. 3)* and incised lines *(Fig. 27.58. 4, 7, Fig. 27.59. 2, Fig. 27.61. 2)*, although curved lines are considerably more frequent *(Fig. 27.58. 1, 6–7, Fig. 27.59. 1–2, 5)*. Two fragments bear a curved incised pattern foreshadowing Szakálhát designs *(Fig. 27.58. 6, Fig. 27.59. 5)*. Incised wavy lines *(Fig. 27.59. 4)* and pairs of wavy lines *(Fig. 27.59. 3)* are typical motifs of the ornamental repertoire. One body sherd is covered with a pattern of densely incised parallel lines broken at right-angles *(Fig. 27.58. 2)*. A pattern of parallel lines filled with short stabs also occurs *(Fig. 27.58. 5)*.

The pottery from Pit 3 of the Békés-Déló site includes many fragments decorated with wavy lines (Goldman 1983, fig. 3. 7–9, 11) and pairs of wavy lines (Goldman 1983, fig. 3. 4, fig. 4. 5, fig. 6. 7, 9, fig. 7. 5, 7), as well as bands filled with short stabs (Goldman 1983, fig. 5. 1, 3–4, 7, fig. 7. 1, 5). Comparable patterns can be quoted from Tarnabod-Nagykert (Kalicz and Makkay 1977, Taf. 129. 25) and Egyek-Rózsástelek (Kalicz and Makkay 1977, Taf. 95. 3). The finds from Ecsegfalva include a sherd covered with incised zig-zagging lines ending in a pointed V *(Fig. 27.60. 6)*. This pattern was quite common in the Middle Neolithic assemblage from Pit 3 of the Békés-Déló site (Goldman 1983, fig. 2. 7–8, fig. 3. 1, fig. 4. 6) and good parallels can also be cited from several late AVK assemblages, such as the ones from Kunszentmárton-Érpart (Kalicz and Makkay 1977, 381, Taf. 185. 51) and Szarvas-Érpart (Kalicz and Makkay 1977, 381, Taf. 185. 10). At Vésztő-Hidashát-Hosszúmalom it is combined with a design of bands filled with short stabs (Kalicz and Makkay 1977, 381, Taf. 185. 52).

Bands filled with shorts stabs, linear patterns and zig-zagging lines ending in a pointed V are generally regarded as the most typical ornamental motifs of the Szarvas-Érpart group (sometimes called Szarvas-Érpart type; Kalicz and Makkay 1966, 44; Kalicz and Makkay 1977, 56; Goldman 1983, 26). Kalicz and Makkay initially defined the Szarvas-Érpart group as an independent local group of the AVK, which post-dated the classical AVK (Kalicz and Makkay 1966, 44, 46). Later, they discarded this idea and interpreted the Szarvas-Érpart type as an expression of late AVK traits occurring in late assemblages, rather than a regional group (Kalicz and Makkay 1977, 56). György Goldman, however, has argued that Szarvas-Érpart type assemblages can be regarded as an independent AVK group in the light of the assemblage recovered from Békés-Déló, Pit 3 (Goldman 1983, 33).

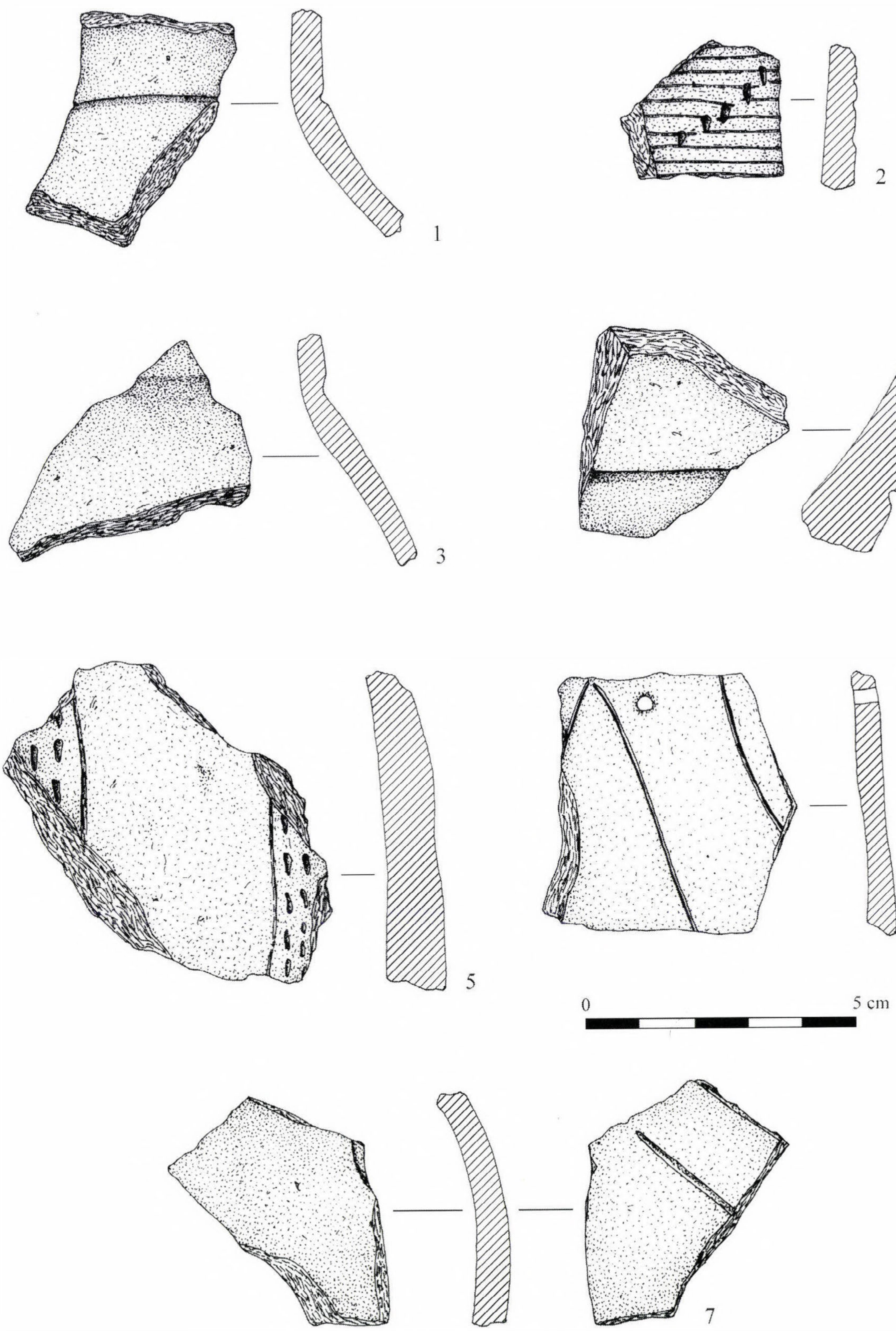


Fig. 27.58. AVK pottery finds

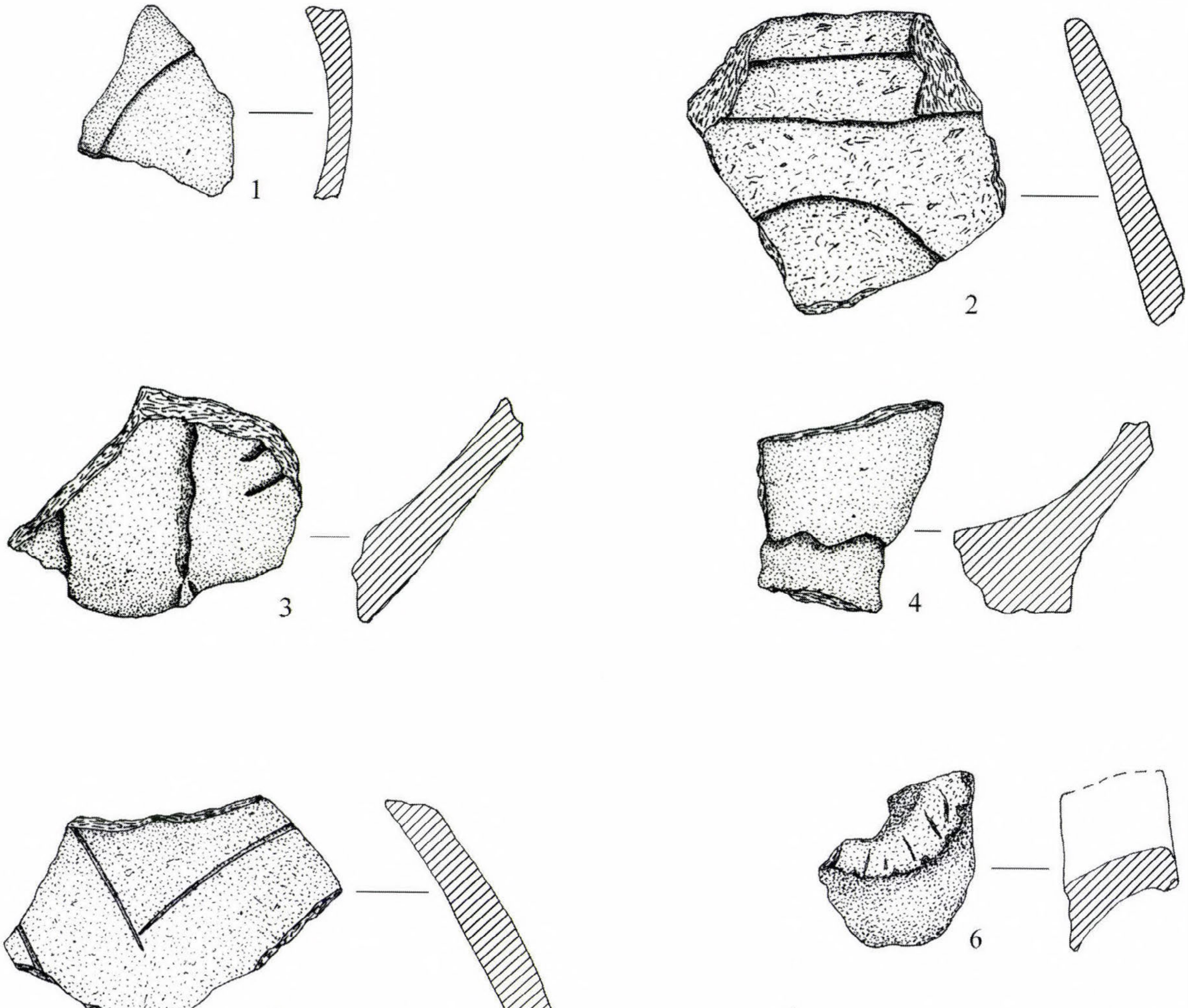


Fig. 27.59. AVK pottery finds

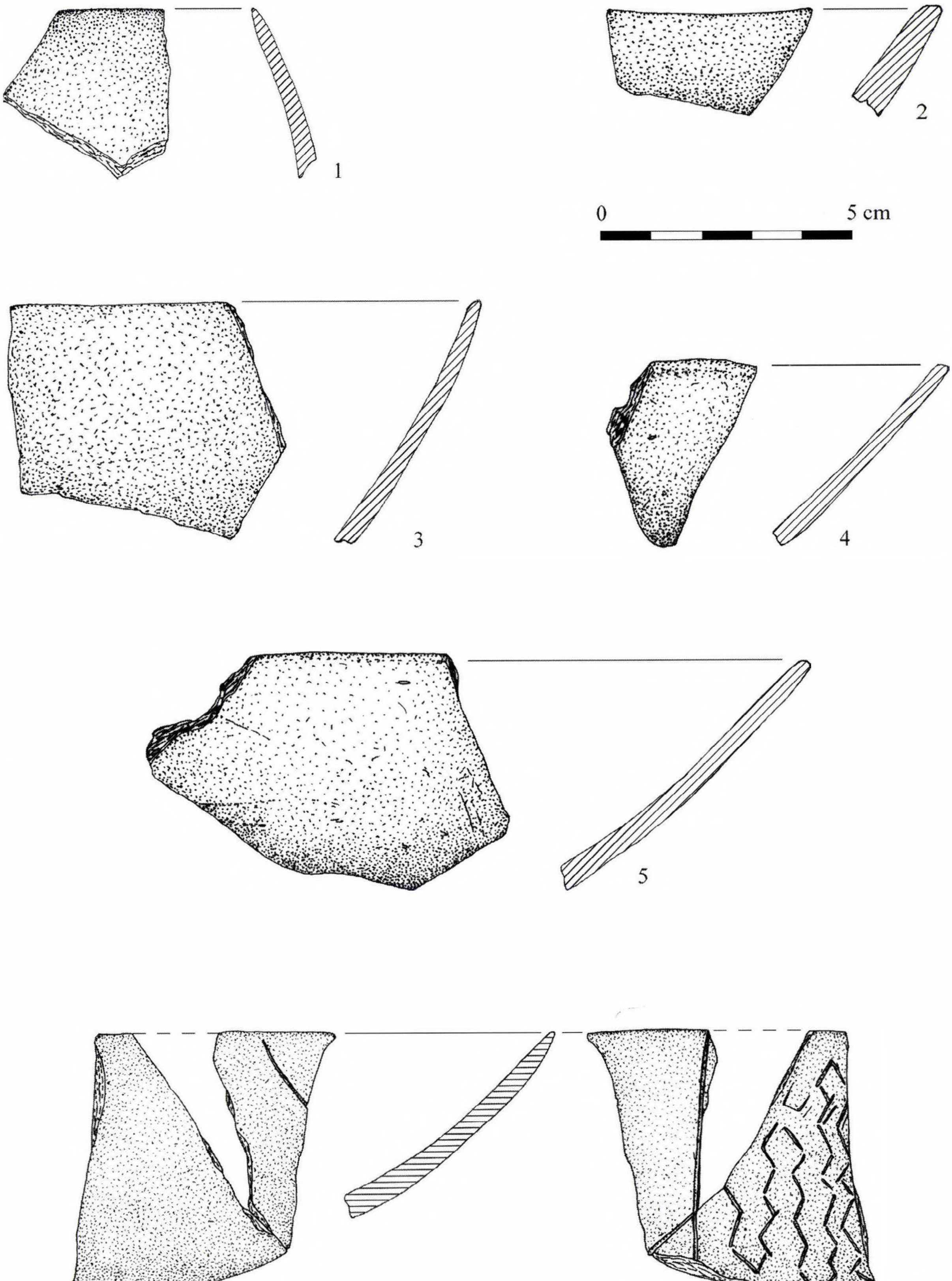


Fig. 27.60. AVK pottery finds

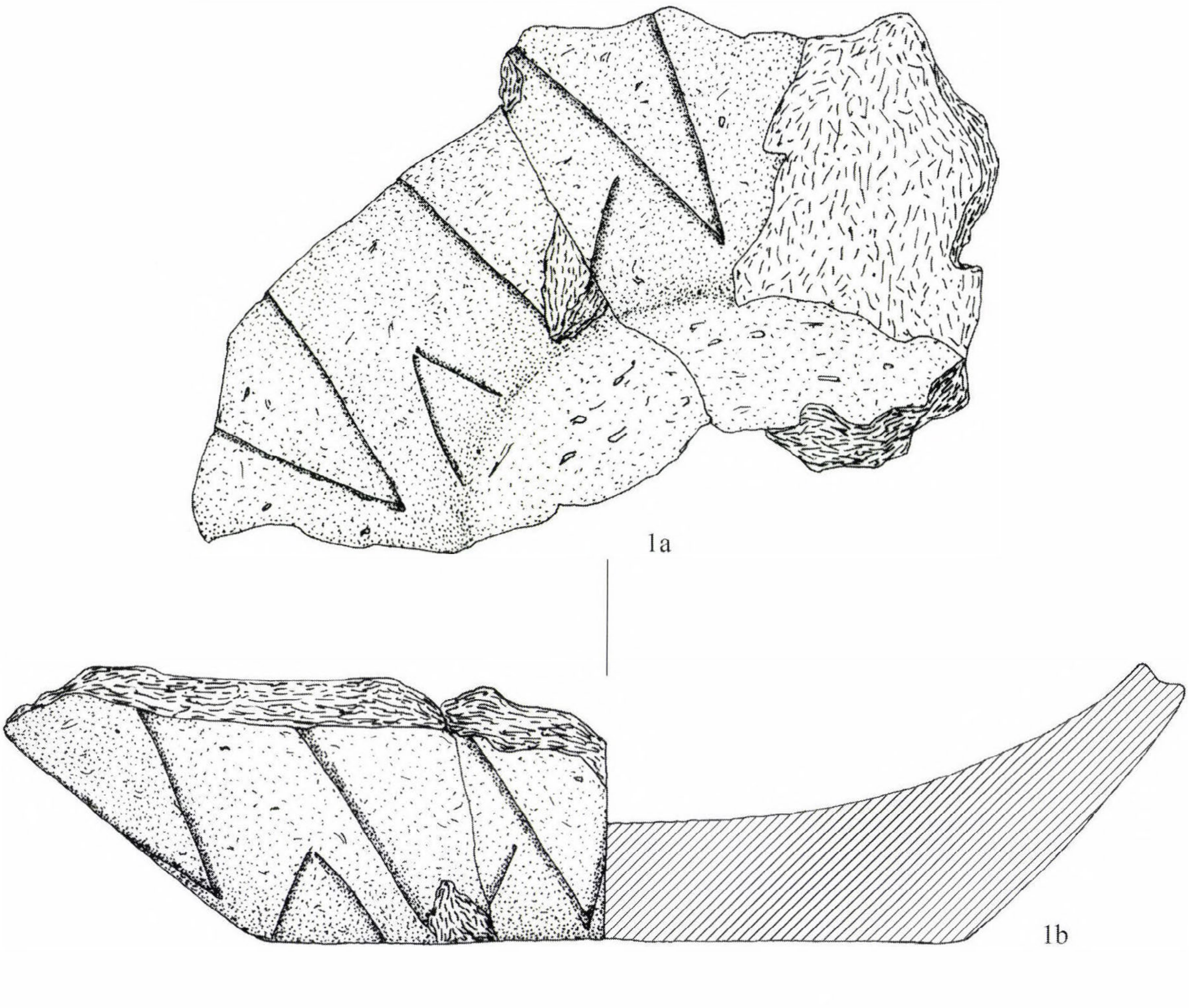


Fig. 27.61. AVK pottery finds

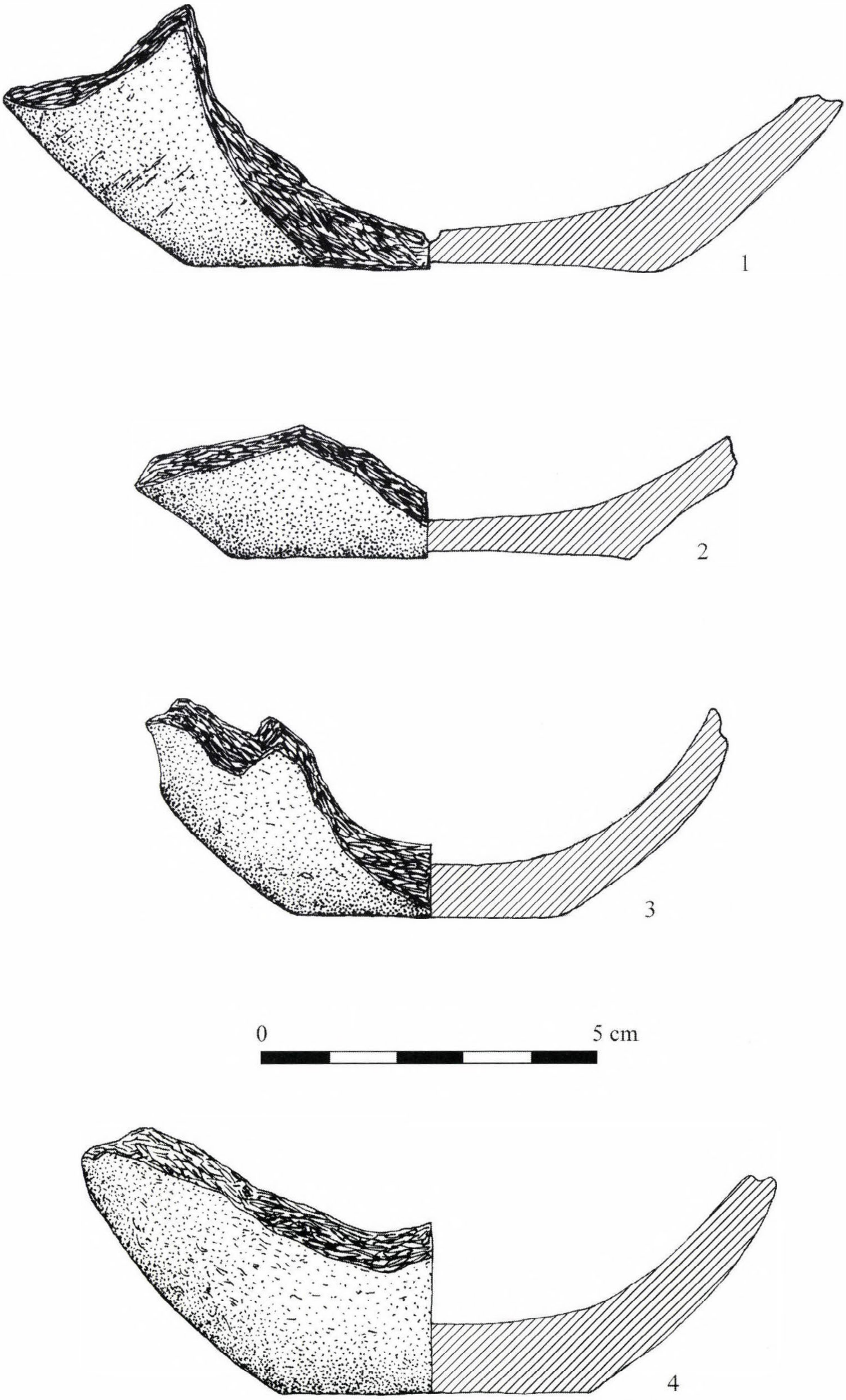


Fig. 27.62. AVK pottery finds

Stratigraphic distribution of Körös and Alföld Linear Pottery finds in Trench A

The general statistical analysis of the finds revealed that AVK finds were chiefly recovered from Trench A, since 98.78 per cent of the AVK finds came to light in this trench, as did 96.38 per cent of the culturally unattributable Early and Middle Neolithic (Körös and AVK) finds. The distribution of Neolithic pottery finds in the thirteen sub-levels forming the layer sequence of Trench A is shown in *Table 27.12*.

Table 27.12. The distribution of Neolithic pottery finds from Ecsegfalva 23, Trench A

Layer sequence	Sub-levels	Körös		Körös/AVK		AVK		Neolithic	
		joined	%	joined	%	joined	%	joined	%
1. AVK	1.1	2	2.53	27	34.18	50	63.29	79	100
	1.2	112	11.85	302	31.96	531	56.19	945	100
2. Körös	2.1	144	63.16	22	9.65	62	27.19	228	100
	2.2	103	81.10	20	15.75	4	3.15	127	100
	2.3	7	100	0	0	0	0	7	100
3. AVK burial	3.1	24	100	0	0	0	0	24	100
2. Körös	2.4	14	100	0	0	0	0	14	100
4. pit fill	4.1	202	100	0	0	0	0	202	100
	4.2	6	100	0	0	0	0	6	100
	4.3	41	100	0	0	0	0	41	100
	4.4	3	100	0	0	0	0	3	100
	4.5	87	97.75	2	2.25	0	0	89	100
	4.6	28	100	0	0	0	0	28	100
Without stratigraphic context		30	96.77	0	0	1	3.23	31	100
Total		**803**	**44.02**	**373**	**20.45**	**648**	**35.53**	**1824**	**100**

The first two sub-levels (1.1 and 1.2) yielded mostly AVK and culturally unattributable Körös/AVK finds, with an absolute dominance of AVK wares. The next two sub-levels (2.1 and 2.2) showed a declining tendency of AVK wares. The lower-lying sub-levels did not yield a single AVK pottery fragment, and only in the case of two sherds was there some uncertainty in their cultural attribution, although their stratigraphic position indicated that they should be assigned to the Körös culture. The radiocarbon date of the burial (sub-level 3.1) assigns the grave firmly to the AVK, while the other pottery finds can be securely linked to the Körös culture. The layer sequence clearly shows that the AVK occupation overlies the Early Neolithic Körös occupation. The burial was no doubt dug into the Early Neolithic occupation levels from one of the upper AVK levels.

Table 27.13. Distribution of AVK pottery from Ecsegfalva 23, Trench B

Layer sequence	Sub-levels	AVK joined
1. topsoil	1.1	4
2. upper occupation level	2.1	4
	2.2	0
	2.3	0
3. occupation levels over contexts 390/394/395	3.1	0
	3.2	0
	3.3	0
	3.4	0
4. pit fill	4.1	0
5. basal levels and pits	5.1	0
Without stratigraphic context		0
Total		**8**

Alföld Linear Pottery (AVK) finds from Trench B

A negligible number of AVK finds, eight pottery sherds, were recovered from Trench B. Their stratigraphic position is shown in *Table 27.13*.

The few AVK pottery sherds came to light from the uppermost levels of the layer sequence. This would suggest that these Middle Neolithic finds were either secondarily deposited here from Trench A and its area, or that the AVK occupation levels overlying the Körös levels had been eroded or destroyed.

Post-Neolithic finds

A total of 83 post-Neolithic pottery fragments were identified among the 11,993 pottery pieces after the restoration of the finds. Thirty came from Trench A, 49 from Trench B and four from Trench C. Forty-four of the 49 sherds from Trench B came to light in sub-levels 1.1 and 2.1. These upper levels were the most affected by later disturbances. In addition to the pottery sherds of the Early Copper Age Tiszapolgár culture, the post-Neolithic finds included Iron Age and post-medieval pottery fragments. Stray finds of the Tiszapolgár culture were also found south-east of the trenches.

Chronology

The relative chronology of the Körös culture

The internal periodisation of the Körös, Starčevo and Criş cultures[15] is one of the principal issues in South-East European prehistory. The find assemblages brought to light in former Yugoslavia allowed the differentiation of successive Starčevo phases (Milojčić 1949a; 1950; Arandjelović-Garašanin 1954; Srejović 1971; Dimitrijević 1969a; 1969b; 1974). The chronological framework for the Romanian Banat was elaborated by Gheorghe Lazarovici (Lazarovici 1979). These chronological systems are largely based on the changes in the style of painted pottery wares. Wolfram Schier has recently discussed the various chronological models and he published a comparison of these schemes (Schier 1997, 157, 163, table 1). The chronologies based on the find assemblages from Croatia, Serbia and Romania have been severely criticised by Makkay (Makkay 1965; 1969, 15–25; 1982b, 31–42). One of the most heated debates raged over the chronological position of the earliest Körös phase relative to the Early Neolithic in the northern Balkans: Vladimir Milojčić synchronised it with the latest Starčevo phase[16] (Milojčić 1949b, 264–65; 1950, 111, 118), while Makkay regarded the Körös and Starčevo cultures as representing a parallel development (Makkay 1965, 4–11; 1969, 16–20, 30).

The periodisation of the Körös culture is beset by several problems, one of these being the negligible number of painted pottery finds. In spite of this deficiency, Makkay and Trogmayer divided the Körös sequence into three main periods on the basis of the culture's painted pottery (Makkay and Trogmayer 1966, 57–58). From his examination of the proportion of barbotine decoration in the pottery assemblages recovered from four sites by the confluence of the Tisza and Maros rivers (Gyálarét-Szilágyi-major, Röszke-Lúdvár, Maroslele-Pana, Deszk-Olajkút 1), Trogmayer concluded that this decoration was absent from the early Körös period and became increasingly more popular towards the end of the culture's life (Trogmayer 1968b).

There are few reliable anchors for the chronological attribution of Körös assemblages. The early appearance of white on red and white on brown dot and lattice patterns is one of these (Makkay 1982b, 41). The former was assigned to Phase IB–IC of the Starčevo-Criş culture (Lazarovici 1979, pl. 2. 21–24, 29), the latter to Phase IIA (Lazarovici 1979, pl. 3. 23–24). Painted pottery sherds of this type have been found, for example, at Szarvas 23-Egyházföld (Makkay 1981, fig. 1. 1–2, fig. 2. 1, 4). Analogies to this painted style can be quoted from various early Körös, Starčevo and Criş sites, such as Gura Baciului/Bácsi torok in Transylvania (Vlassa 1972, Taf. 15. 1/1–10, 2/1–10, Taf 16. 1/1–4, 9; Lazarovici and Maxim 1995, colour pl. 1. 1–5, colour pl. 2. 7, 9, colour pl. 3. 2, colour pl. 4. 1–3, colour pl. 5. 2–4, 11–13, colour pl. 8. 1–4), Cârcea-La Hanuri[17] in Oltenia (Nica 1977, fig. 2. 1; fig. 5. 1a–b; Makkay 1982b, 39), and Donja Branjevina in south-western Bačka/Bácska (Karmanski 1979, T. XVII. 1–4, 6–7, T. XX. 1–6, T. XXI. 1–2, T. XXII. 6–7, T. XXIV. 3–9; 2005, pls 82–88).

Another cornerstone of the generally accepted internal periodisation of the Körös culture is the presence of formal and stylistic traits associated with the culture's late phase, which are absent from assemblages linked to the culture's early period. The evaluation of these assemblages is vital to the interpretation of the finds from Ecsegfalva, and these traits, together with the evidence supporting them, will therefore be discussed at greater length below.

The label 'Protovinča' enjoys a unique status in the research of the late phase(s) of the Körös, Starčevo and Criş cultures. Even though it has come under heavy criticism and has been often re-interpreted or even discarded, it has nonetheless made its way into mainstream archaeological literature and cannot be sidestepped. The expression 'Protovinča horizon' was introduced by Dragoslav Srejović to describe the appearence of typical early Vinča vessel forms and decorations – which he derived from Anatolia – on sites beyond the Starčevo distribution (such as Vršnik, Drama, Karanovo and others; Srejović 1963, 7).

In Hungary, Makkay discussed the final Körös phase as the single securely distinguishable horizon in the Körös-Starčevo complex. He linked this horizon to one of the most important events in the region's prehistory, the appearance of the earliest Vinča elements. In Makkay's usage, the term 'Protovinča period' described this development (Makkay 1969, 25). Makkay regarded the Protovinča horizon as pre-dating the Vinča A phase and interpreted it as a local, indigenous development, although he conceded that cultural impacts from the south played a role in triggering this development (Makkay 1982b, 26–29). He argued that the emergence of the Vinča culture in the area between the Körös and Maros rivers was blocked by the southern expansion of the AVK (Makkay 1982b, 29–31).

Makkay's 'Protovinča' theory came under heavy critical fire. Raczky argued that the Szatmár II/AVK 1 sites north of the Kunhegyes–Berettyóújfalu line and the late Körös (Protovinča) assemblages were co-eval. He linked the appearance of biconical vessels, black burnished pottery and *Schlickwurf* barbotine to the onset of the Middle Neolithic in the northern Balkans and the emergence of the Vinča culture, synchronising this horizon with the Vinča A phase. He interpreted the presence of Vinča A vessel forms and ornamental elements in late Körös assemblages as an impact of the already formed Vinča culture, this being the reason that he synchronised Szatmár II/AVK 1 and late Körös (Protovinča) with Vinča A, and argued that the label 'Protovinča' was rather anachronistic in this sense (Raczky 1983b, 188; 1986, 33–35; 1988, 28). He noted that the traits lumped under the label 'Protovinča' appeared not only in the areas north of the Maros in the Great Hungarian Plain, but also in other regions, where the Early Neolithic was not followed by the Vinča culture (Tsonevo, Karanovo II–III transition). He cited the biconical forms and the stroke-burnished patterns appearing in the ceramic assemblage from Szajol-Felsőföld which, however, were not as pronounced as at Öcsöd-Kiritó-nyugati part. He therefore assumed a Körös phase, which directly preceded the late Körös phase described as 'Protovinča', and pre-dated the horizon marked by the assemblages from Maroslele-Pana, Pit 3, Dévaványa-Atyaszeg and Öcsöd-Kiritó-nyugati part (Raczky 1983b, 189; 1986, 35; 1988, 28–29). This also implied that the cultural impacts stimulating the appearance of these new traits were earlier than the Szatmár II/AVK 1–late Körös (Protovinča)–Vinča A horizon. Kalicz rejected the 'Protovinča' label on the grounds that the Vinča culture did not appear in the Hungarian distribution of the Körös culture (Kalicz 1993, 92; 1994, 71, 78). Ferenc Horváth and Ede Hertelendi accepted Raczky's view regarding both the usage of the label 'Protovinča' and the chronological position of these finds (Horváth and Hertelendi 1994, 115).

Makkay later subdivided the Protovinča period into two sub-phases. He assigned the finds from Maroslele-Pana, Pit 3, to the early phase, and the assemblages from Szarvas 23-Egyházföld, Trench VIII, Pit 1, and Endrőd 39-Szujókereszt, Trench XVIII, Pit 1, to the late Protovinča phase (Makkay 1987, 16, 18). He contended that the transition from the late Körös and Starčevo culture to the Vinča culture had begun over the entire Körös-Starčevo distribution in the Great Hungarian Plain. From the Szatmár and early AVK imports on Körös sites he concluded that the Szatmár group, representing the formative AVK phase, had emerged north of the Körös-Starčevo distribution by the classical Körös phase. The AVK later gradually occupied the former Körös territories, expanding to the Körös valleys by the late Szatmár phase. During the transition from Protovinča to Vinča A, the early and classical AVK spread to the Maros valley (Makkay 1987, 23). Protovinča finds preceding the Vinča complex can be distinguished not only in the latest, but also in earlier Körös-Starčevo assemblages (Makkay 1990b, 113). Traits foreshadowing the Vinča culture can thus be found in both classical and late Körös assemblages, although they sporadically occur in the early Körös-Starčevo phase too. These traits cannot be interpreted as reflecting cultural impacts from the Vinča A culture because a number of Vinča A traits cannot be demonstrated in Protovinča assemblages. Makkay synchronised the new, Protovinča elements with the Szatmár group (representing the formative AVK) and dated it to the second half of the classical Körös period (Makkay 1990b, 121). He re-iterated his view that the emergence of the Vinča culture from the Protovinča phase north of the River Maros was prevented by the southern expansion of the AVK (Makkay 1990b, 121–22). Responding to the criticism voiced by Kalicz, Raczky and Horváth, he emphasised the chronological position of the Protovinča period (preceding Vinča A) and the fact that in his usage, the label 'Protovinča' denoted also forms other than the ones appearing at the end of the Körös sequence (Makkay 1996, 44–46).

Based on his statistical analysis of the late Körös assemblage from Dévaványa-Réhely, Goldman distinguished an earlier and a later phase. He introduced the Réhely I and Réhely II phase labels, but these did not take root in the archaeological vocabulary (Goldman 1991).

Schier contrasted Srejović's interpretation of the Protovinča label, which in his usage denoted a cultural-regional phenomenon, with Makkay's interpretation, which expressed a chronological horizon (Schier 1997, 157). In Schier's view, Makkay had set up a model of successive waves of cultural impacts from the south, the earliest of which could be dated to the Szatmár I phase and the later half of the classical Körös period[18] (Schier 1997, 158). Schier apparently misunderstood the cited passage of Makkay's study (Makkay 1990b, 121), for the Szatmár phase of the AVK is identical with Szatmár II, and not Szatmár I (used for denoting Méhtelek type Körös assemblages).[19] Schier also analysed the pottery forms assigned to the Protovinča horizon, comparing them to the re-interpreted finds from Vinča-Bjelo Brdo (Schier 1996), and concluded that while the assemblages in question indeed share a number of similarities, they have very little in common with typical Vinča A forms. The closest analogies can in fact be quoted from Vinča B2 and early Vinča C pottery (Schier 1997, 158–59). Seeing that the contemporaneity of Protovinča with these Vinča phases can obviously be rejected, Schier suggested two possible explanations for this phenomenon. The first, that the new cultural traits are unconnected to the early Vinča culture, the implication being that their chronological position needs to be re-defined. The second explanation is a variation on Srejović's original suggestion, according to which the new traits appearing in the late Starčevo phases and the emergence of the Vinča culture were part of a general cultural change in south-east Europe, whose impact differed from region to region (Schier 1997, 159). Schier agrees with Makkay that the typical Protovinča traits fall into different chronological horizons (Schier 1997, 160). In Schier's proposed chronological scheme, early Protovinča in the southern part of the Great Hungarian Plain precedes the earliest Vinča phase and is synchronous with Stojan Dimitrijević's Spiraloid A phase, the late Körös horizon in the Tisza and Körös region, and the Szatmár I group (i.e. Méhtelek-type Körös assemblages). He equated the late Protovinča phase with the Vinča A1 phase, the Starčevo Spiraloid B phase, the latest Körös assemblages and the earliest AVK represented by the Szatmár II group (Schier 1997, 163, table 1–2). Schier thus synchronised the early Protovinča period with Lazarovici's Starčevo IIIB, the late Protovinča period with Starčevo IVA (Schier 1997, 163, table 1), although he retained Dimitrijević's scheme of Vinča beginnings based on Serbian sites (Schier 1997, 163, table 2).

Certain types of burnished patterns or designs incised into polished vessel surfaces have been unfailingly included among the traits characterising late Körös assemblages. Makkay raised a number of new points in the light of the culture's fine wares decorated using these techniques. He proposed five categories – pattern-burnished,[20] impressed,[21] incised before firing,[22] incised after firing,[23] and channelled[24] – which he illustrated with the pottery from the Körös sites he had excavated in the Körös region (Makkay 2000, 311–12). In Makkay's opinion, the use of these decorative techniques can be traced from the earliest Körös phases, with the exception of channelled decoration (Makkay 2000, 312). He attributed the appearance of pattern-burnished and *eingeglättet* motifs in the early Transdanubian Linear Pottery assemblage from Bicske-Galagonyás to the impact of the Körös culture (Makkay 2000, 312).[25] In a recent study, Makkay noted that burnished and finely incised patterns were much more widespread than earlier believed (Makkay 2004, 20).[26]

The relative chronological position of the Ecsegfalva 23 site

The statistical analysis of the distribution frequencies of the main ornamental motifs and carinated vessels in Trench B of the Ecsegfalva 23 site revealed that each of the examined traits can be traced throughout the site's occupation and that their frequency by and large corresponds to the proportion of pottery in individual sub-levels compared to the entire ceramic assemblage. A major stylistic change cannot be observed during the settlement's life-span, meaning that the site's Early Neolithic occupation was of a fairly brief duration and did not span major chronological phases determined on typological grounds. The three trenches lay quite close to each other and carinated vessel forms, for example, were recovered from Trenches A and C too. There is no reason to discuss the pottery finds from the three trenches separately.

Many ceramic traits have their parallels in the late Körös assemblages, among the finds recovered from sites of the Protovinča period. Carinated vessels are perhaps the most diagnostic of these. Close analogies to the biconical forms, including bowls with a flat base, whose upper part above the carination is smaller than the lower part, vessels with a sharp carination decorated with small knobs, and biconical vessels with splayed rim (*Lippenrand*) can be quoted from Öcsöd-Kiritó-nyugati part (Raczky 1988, pls 5–8), Endrőd 6 (Makkay 1990b, pl. 1. 10, 12, pl. 3. 10–11, 13–17) and Dévaványa-Atyaszeg (Oravecz 1995, 63, Abb. 1. 1–2, 6–7). A comparison with the finds from the Endrőd 119-Öregszőlők site is instructive since similarly to the assemblage from Ecsegfalva 23, carinated vessels have been found at the site, even if sporadically (Makkay 1992, pl. 1. 1–2, 5).

Little is known about the proportion of carinated vessels in the pottery from late Körös sites, and about whether the proportion of carinated vessels increases in the known pottery assemblages during the period characterised by these wares. If an increase in the proportion of carinated vessels is assumed, the Ecsegfalva site can be assigned to the beginning of this period since the proportion of carinated forms in Trench B is 1.045 per cent, and a truly marked carination could only be noted on some vessel fragments. The finds from Pit 3 of the Maroslele-Pana site suggest that vessels with a sharp carination decorated with small knobs appear in the assemblages dated to the early Protovinča phase (Trogmayer 1964, fig. 6. 1–2, 12, fig. 7. 8; Makkay 1990b, 117, pl. 3.

18–20,[27] 119). According to Trogmayer, carinated wares accounted for 1.1 per cent of the pottery finds (i.e. four sherds out of the 362 pottery fragments recovered from Pit 3). Channelled barbotine and *Schlickwurf* decoration made up 5.6 per cent of the finds (Trogmayer 1964, 68, 70). At Tiszajenő-Szárazérpart, biconical forms added up to 0.7 per cent of the finds, and *Schlickwurf* was observed on seven sherds of the ceramic inventory from the site, which numbered 2174 sherds. Raczky dated the assemblage to the phase immediately preceding Maroslele-Pana, Pit 3, which in his opinion could be synchronised with Dimitrijević's Girlandoid phase (Raczky 1976, 171, 186–87). This phase corresponds to the Starčevo IIIA phase in Lazarovici's chronological scheme (Schier 1997, 163, table 1).

The occurrence of polished pottery fragments and stroke-burnished linear patterns at Ecsegfalva 23 too confirms the dating suggested by Raczky (1988, 28). A few traits typical of the late Körös culture, such as channelled barbotine and fine channelling, are lacking from the Ecsegfalva pottery assemblage. The lack of the former is not necessarily a chronological indicator, while the latter is the single decorative technique listed by Makkay, which only appears in the latest Körös assemblages (Makkay 2000, 312).

Lazarovici assigned vessels resembling the biconical and carinated wares from Ecsegfalva to his Starčevo IVA and IVB phases (Lazarovici 1979, pl. 8/A, pl. 9/A). Good parallels to the Ecsegfalva pottery can be found in Starčevo IVA assemblages, such as Layer III of the Ostrovu Golu site (Lazarovici 1979, pl. 8/A).

In the light of the quoted parallels from other Körös assemblages which, according to the generally accepted classification schemes, date from the culture's late phase, the Ecsegfalva assemblage can be dated to the late Körös period on typological grounds. There are indications that this settlement can be assigned to the beginning of the period best typified by carinated wares. In terms of a broader framework, the Ecsegfalva finds can be correlated with Starčevo IVA in Lazarovici's chronological scheme.

The chronological schemes for the internal periodisation of the Starčevo culture are predominantly based on find assemblages from the Banat, the Srem and Slavonia. These regions (and their sites) lie many hundreds of kilometres south of the Berettyó valley, where Ecsegfalva is located. It is more than doubtful whether the typo-chronological observations made in these southerly regions can be wholly synchronised with various phases of the sites in the northern Körös distribution. Hungarian prehistorians rarely used these categories for defining the chronological position of a particular site; instead, they described sites as being early, classical or late Körös (Protovinča). In this framework, the early phase is characterised by the presence of white painted pottery, while the late phase by the occurrence of formal and stylistic elements associated with the Protovinča horizon. Find assemblages lacking the traits of the early or late phase are generally assigned to the classical Körös phase. If, however, we accept Makkay's claim that many Protovinča traits had appeared much earlier and were in fact widespread by the second half of the classical Körös phase (Makkay 1990b, 121), the question inevitably arises as to how the classical and late Körös phases should be re-defined and how a boundary can be drawn between these two periods.

The absolute chronology of the late phase(s) of the Körös culture

This section offers an overview of the radiocarbon dates available for sites in the Great Hungarian Plain, whose find assemblages were assigned to the late Körös phase on typological grounds and whose finds have been published to some extent. The radiocarbon dates for these sites fall within rather wide brackets *(Table 27.14)*.

Table 27.14. Radiocarbon dates of late Körös sites in the Great Hungarian Plain

Laboratory no.	Site	Feature	BP date	cal BC (68.2%)[28]	Reference
Bln-581	Deszk-Olajkút 1	Pit 8	6605±100	5630–5470	Quitta and Kohl 1969
Bln-584	Deszk-Olajkút 1	Pit 8	6540±100	5620–5370	Quitta and Kohl 1969
Bln-583	Deszk-Olajkút 1	Pit 15	6410±100	5480–5300	Quitta and Kohl 1969
Bln-582a	Deszk-Olajkút 1	Pit 15	6390±100	5480–5260	Quitta and Kohl 1969
Bln-582	Deszk-Olajkút 1	Pit 15	6260±100	5330–5060	Quitta and Kohl 1969
OxA-9376	Deszk-Olajkút 1	Grave 5	6225±55	5300–5070	Whittle *et al.* 2002
OxA-9396	Deszk-Olajkút 1	Grave 6	7030±50	5990–5840	Whittle *et al.* 2002
BM-1863	Endrőd 39	Trench IV, Pit 1	6840±110	5840–5630	Burleigh *et al.* 1983
BM-1863R[29]	Endrőd 39	Trench IV, Pit 1	6950±140	5990–5710	Bowman *et al.* 1990
BM-1871	Endrőd 39	Trench XIX, Pit 1	6470±70	5490–5360	Burleigh *et al.* 1983
BM-1871R[30]	Endrőd 39	Trench XIX, Pit 1	6830±120	5840–5620	Bowman *et al.* 1990
BM-1868	Endrőd 39	Trench XVIII, Pit 1	6830±60	5770–5640	Burleigh *et al.* 1983
BM-1868R[31]	Endrőd 39	Trench XVIII, Pit 1	6970±110	5980–5730	Bowman *et al.* 1990
BM-1870	Endrőd 39	Trench XVIII, Pit 1	6600±80	5620–5470	Burleigh *et al.* 1983
BM-1870R[32]	Endrőd 39	Trench XVIII, Pit 1	6950±120	5980–5720	Bowman *et al.* 1990
OxA-9587	Endrőd 119	Square 32	6915±45	5840–5730	Whittle *et al.* 2002
OxA-9583	Endrőd 119	Square 32	6895±45	5840–5720	Whittle *et al.* 2002
OxA-9588	Endrőd 119	Square 29	6855±45	5790–5660	Whittle *et al.* 2002
OxA-9586	Endrőd 119	Square 32	6850±45	5780–5660	Whittle *et al.* 2002
OxA-9582	Endrőd 119	Square 33	6825±45	5735–5640	Whittle *et al.* 2002
OxA-9584	Endrőd 119	Square 29	6825±45	5735–5640	Whittle *et al.* 2002
OxA-9590	Endrőd 119	Square 33	6815±50	5730–5640	Whittle *et al.* 2002
OxA-9585	Endrőd 119	Square 27	6795±50	5720–5635	Whittle *et al.* 2002
OxA-9589	Endrőd 119	Square 35	6720±45	5710–5560	Whittle *et al.* 2002
deb-2733	Maroslele-Pana	Pit 4	7497±56	6420–6250	Horváth and Hertelendi 1994
OxA-9399	Maroslele-Pana	Grave 1	6965±50	5890–5740	Whittle *et al.* 2002
OxA-9400	Maroslele-Pana	Grave 3	6740±50	5720–5560	Whittle *et al.* 2002
OxA-10149	Maroslele-Pana	Grave 3	6845±50	5780–5660	Whittle *et al.* 2002
OxA-9401	Maroslele-Pana	Grave 5	6780±50	5720–5635	Whittle *et al.* 2002
OxA-9402	Maroslele-Pana	Grave 6	4460±45	3330–3020	Whittle *et al.* 2002
OxA-9403	Maroslele-Pana	Grave 7	7765±55	6650–6500	Whittle *et al.* 2002
deb-473	Szajol-Felsőföld	Square 5, Grave 2	7100±230	6210–5730	Bognár-Kutzián and Csongor 1987
deb-474	Szajol-Felsőföld	'House', Grave 3	6430±220	5650–5050	Bognár-Kutzián and Csongor 1987
BM-1866	Szarvas 23	Trench IX, Pit 1	6620±60	5620–5480	Burleigh *et al.* 1983
BM-1866R[33]	Szarvas 23	Trench IX, Pit 1	6780±110	5780–5560	Bowman *et al.* 1990
BM-1865	Szarvas 23	Trench VIII, Pit 1[34]	6190±140	5300–4950	Burleigh *et al.* 1983
BM-1865R[35]	Szarvas 23	Trench VIII, Pit 1	6400±170	5530–5080	Bowman *et al.* 1990
OxA-9375	Szarvas 23	Grave 1	6855±55	5800–5660	Whittle *et al.* 2002

Szajol-Felsőföld

With their rather high standard deviation and the significant difference of 600–700 years, the two dates for Szajol-Felsőföld represent a broader time interval than is usually accepted for the Early Neolithic of eastern Hungary. The radiocarbon dates neither support, nor challenge the site's chronological position suggested by Raczky (Raczky 1988, 29). Since the pottery assemblage recovered during the excavation of the site is still unpublished, it is possible that the Körös occupation was quite long, spanning several successive phases.

Endrőd 119-Öregszőlők

The series of nine radiocarbon dates is rather uniform, with a group calibration giving a range of Sum 5780–5640 cal BC. The samples were taken from the site's south-western part, mainly from Pit 12 (Whittle *et al.* 2002, 74). The finds from this site include a few carinated fragments with small knobs set on the carination and so-called metallic ware (Makkay 1992, pl. 1. 1, 5). In Makkay's estimate, the site's occupation spanned no more than four generations. He also considered the possibility that the two Early Neolithic houses were not contemporaneous, but were occupied successively for fifty years each. He suggested that life on the settlement came to an end sometime before the late Körös-Starčevo (Protovinča) period (Makkay 1992, 127–28). He conceded, however, that the white painted pottery from Pit 12 was at odds with this chronology (Makkay 1992, 127) and that pottery finds typical for all phases of the Körös sequence could be identified in the ceramic inventory (Makkay 1996, 37, note 12).[36]

Maroslele-Pana

Of the seven radiocarbon dates for the site, the 5890–5740 cal BC date for Grave 1 (OxA-9399) corresponds to an early Körös period. The grave lay by the western edge of Pit 4, which the excavator regarded as the earliest settlement feature uncovered on the site (Trogmayer 1964, 67, 83–84). The date of 6420–6250 cal BC (deb-2733) for a sample from the same pit is earlier than the conventional date of 6100/6000 cal BC for the start of the Körös, Starčevo and Criş cultures. The three dates for samples taken from Graves 3 and 5 are rather uniform. Grave 3 lay beyond the northern wall of Pit 4 and the combined date from two measurements was 6793±35 BP, i.e. 5715–5640 cal BC (OxA-9400 and OxA-10149). The remains of Grave 5 were identified in Pit 7, and the sample yielded a date of 5720–5635 cal BC (OxA-9401) (Trogmayer 1964, 67–68; Whittle *et al.* 2002, 115–16). The date of 3330–3020 cal BC (OxA-9402) for Grave 6 corresponds to the Late Copper Age in Hungary (Baden culture), while the date of 6650–6500 cal BC (OxA-9403) for Grave 7 pre-dates the start of the Hungarian Neolithic. Trogmayer was uncertain as to the chronological position of the two latter burials, especially in view of the fact that they could not be associated with any settlement features (Trogmayer 1964, 67). None of the dates for the Maroslele site come from samples taken from Pit 3, whose finds represent the early Protovinča phase (Makkay 1987, 16; 1990b, 119).

Endrőd 39-Szujókereszt

Of the dates from this site, the results for the samples from Pit 1 in Trench XVIII are especially important. Makkay dated this pit to the late Körös (Protovinča) period (Makkay 1987, 18; 1990b, 120) or, to be more precise, to the terminal Körös phase (Makkay 1987, 16, 18). The calibrated dates provided by the re-evaluated samples[37] for this pit (BM-1868R and BM-1870R) fall between 6000–5700 cal BC, which can hardly be regarded as late, for they can be grouped among the earliest radiocarbon dates for the Körös culture. The two measurements yielded a combined radiocarbon date of 6961±81 BP, 5970–5730 cal BC for the pit.

Szarvas 23-Egyházföld

The re-evaluated radiocarbon date (BM-1865R) for Pit 1 of Trench VIII[38] of this site comes from a sample taken from a feature dated to the late phase of the Protovinča period in view of its finds (Makkay 1987, 16, 18; 1990b, 120). The 5530–5080 cal BC range spans a part of the Middle Neolithic in eastern Hungary (which can be attributed to the broad standard deviation). The calibrated date with a probability of 63.1% is 5530–5200 cal BC. Disregarding the inaccuracies resulting from the standard deviation, the date confirms the attribution of the pit to the latest Körös phase. However, the dates for Pit 1 of Trench IX (5780–5560 cal BC; BM-1866R) and Grave 1 (5800–5660 cal BC; OxA-9375) suggest an occupation in an earlier phase too.

Deszk-Olajkút 1

The radiocarbon dates for this site correspond to the site's chronological position determined by the typology of the pottery finds, which can be linked to the late Körös period. The radiocarbon dates for Pit 8 and Pit 15 fall into two different periods. The combined radiocarbon date for Pit 8 is 6573±71 BP, i.e. 5620–5470 cal BC, while the one for Pit 15 is 6400±71 BP, i.e. 5470–5310 cal BC (Bln-582a and Bln-583). Another combined date for Pit 15 is 6354±58 BP, i.e. 5470–5260 cal BC (Bln-583, Bln-582a and Bln-582), a value partly post-dating the Early Neolithic.[39] The difference between the chronological position of the two pits was noted by Trogmayer in his analysis based on the proportion of barbotine decoration; he suggested that Pit 8 was the earlier of the two (Trogmayer 1968b, 8, 11, fig. 1). Instead of clarifying the site's chronology, the dates for the two burials uncovered at the site complicated issues further. The date of 5300–5070 cal BC for Grave 5 falls into the Middle Neolithic (AVK), while the date of 5990–5840 cal BC for Grave 6 corresponds to a rather early Körös period.

Radiocarbon dates from Golokut-Vizić and Cârcea-Viaduct are available for the late Starčevo and late Criş sites in neighbouring regions *(Table 27.15)*. The former site represents the local Spiraloid B phase in the Vojvodina/Vajdaság region of Serbia, while the latter the latest, Criş IV horizon in Oltenia.

With the exception of Bln-2354, which yielded a date over five hundred years after the Early Neolithic, the other dates are fairly consistent. The five dates for Golokut-Vizić correspond to Sum 5610–5470 cal BC, the ones for Cârcea-Viaduct (Bln-1981, Bln-1982 and Bln-1983) to Sum 5490–5320 cal BC. The dates for Pits 8 and 15 of the Deszk-Olajkút 1 site fit neatly into this series.

Table 27.15. The radiocarbon dates for Golokut-Vizić and Cârcea-Viaduct

Laboratory no.	Site	Feature	BP date	cal BC (68.2%)	Reference
OxA-10147	Golokut-Vizić	Trench 40, Pit 15	6590±50	5610–5480	Whittle *et al.* 2002
OxA-8616	Golokut-Vizić	Trench 40, Pit 15	6560±50	5610–5470	Whittle *et al.* 2002
OxA-8505	Golokut-Vizić	Trench 25a	6550±55	5610–5470	Whittle *et al.* 2002
OxA-8694	Golokut-Vizić	Trench 30	6525±50	5610–5380	Whittle *et al.* 2002
OxA-8695	Golokut-Vizić	Trench 30	6520±50	5600–5380	Whittle *et al.* 2002
Bln-1981	Cârcea-Viaduct		6540±60	5610–5390	Mantu 2000
Bln-1982	Cârcea-Viaduct		6430±60	5480–5340	Mantu 2000
Bln-1983	Cârcea-Viaduct		6395±60	5470–5310	Mantu 2000
Bln-2354	Cârcea-Viaduct		5860±60	4800–4610	Mantu 2000

Table 27.16. The relative and absolute chronology of the Körös culture proposed by Horváth and Hertelendi 1994

Cluster		Körös phase	Protovinča phases	Starčevo/Vinča phase	cal BC
I–II		Early and Middle Körös period			6300–5500
III	First half	Körös III	Szajol	Starčevo IIIA	5500–5400
	Second half		Protovinča 1	Starčevo IIIB/Vinča A1	
IV	First half	Surviving Körös culture	Protovinča 2	Starčevo IVA/Vinča A1–2	5400–5300
	Second half		AVK 2	Starčevo IVB/Vinča A2	

Hertelendi and his colleagues dated the Early Neolithic between 5860–5310 cal BC in their absolute chronology of the Neolithic in eastern Hungary based on calibrated radiocarbon dates. The early Körös period was dated to 5950–5400 cal BC on the basis of fourteen samples, the late Körös (Protovinča) period to 5770–5230 cal BC, also based on fourteen samples (Hertelendi *et al.* 1995, 240, 242). The radiocarbon dates for the two Körös periods overlap to a great extent.

Horváth and Hertelendi proposed an absolute chronology for the Early and Middle Neolithic of the Tisza region based on already published dates and a series of new ones. One of the cornerstones of their chronological framework was that the Vinča A phase began around 5400 cal BC. Accepting this scheme, the Vinča A1 phase and the earliest Protovinča settlements should fall between 5400–5350 cal BC, assuming the synchroneity of Vinča A1 and Protovinča. The Vinča A distribution did not extend to the areas north of the Maros river, which were occupied by the AVK and Szakálhát culture during the Middle Neolithic, while the late Körös (Protovinča) sites occur both north and south of the river. From this regional distribution they concluded that some of the Protovinča sites pre-dated the Vinča A settlements in the Maros region (Horváth and Hertelendi 1994, 114). They resolved this contradiction by accepting the chronological position of Gornea/Felsőlupkó and Liubcova-Orniţa/Alsólupkó in the southern Banat proposed by Romanian research, according to which these sites pre-dated the lowest Vinča levels of the Vinča-Bjelo Brdo site and could be assigned to the Vinča A1 phase in the Romanian Banat (Lazarovici 1979, 106–12, Tab. 17–18; Luca 1991, 152–54). These two sites were thus regarded as predating also the Vinča A settlements in the northern Banat, leading to the assumption that certain Protovinča sites in the northern Banat did not predate the earliest Vinča phase (Horváth and Hertelendi 1994, 115). Horváth and Hertelendi distinguished eight clusters, the first four of which represent the period discussed here (Horváth and Hertelendi 1994, 112–14, 118; *Table 27.16*).

The extreme early chronological positioning of the early Körös culture around 6300 cal BC can most likely be attributed to their acceptance of the 6420–6250 cal BC date for Maroslele-Pana, Pit 4 (deb-2733),[40] even though they did not assign this date to any of their clusters. By accepting the relative chronological position proposed by Romanian research for Gornea/Felsőlupkó and Liubcova-Orniţa/Alsólupkó, the Protovinča 1 period could be synchronised with Lazarovici's Starčevo IIIB/Vinča A1 phase (Lazarovici 1979, Tab. 17; 1984, 134). This chronological scheme harmonises with Raczky's framework, in which the late Körös (Protovinča) period is correlated with Vinča A and the Szatmár II/AVK 1 phase (Raczky 1983b, 187–88; 1986, 34; 1988, 29). One rather grave consequence of this framework is that compared to a rather long early and classical Körös development, the two phases of the late Körös (Protovinča) period are squeezed into the roughly one hundred years from *ca.* 5450 to 5350 cal BC (Horváth and Hertelendi 1994, 118).

In his dissertation, Laurens Thissen discussed the chronology and cultural contacts between the early agricultural communities in Anatolia and the northern Balkans (Thissen 2000). He also devoted a section to the absolute chronology of the Körös culture. One of the shortcomings of this study is that he used the unrevised dates from the British Museum laboratory,[41] as a result of which the dates for Battonya-Basarága, Endrőd 35-Öregszőlők II, Endrőd 39-Szujókereszt and Szarvas 23-Egyházföld are several hundred years younger than their genuine age (Thissen 2000, 285–86, 297–98). He disregarded the dates published by Horváth and Hertelendi, including the early date for Röszke-Lúdvár (deb-2730) based on a sample taken from a context preceding the late Körös period, which yielded a date of 6972±59 BP (Horváth and Hertelendi 1994, 122), corresponding to 5970–5750 cal BC. Thissen rejected the early date of 7090±100 BP, i.e. 6060–5840 cal BC (Bln-75) for Gyálarát-Szilágyi-major (Kohl and Quitta 1963, 299) on the grounds that according to Trogmayer, AVK sherds had also been recovered from the pit from which the sample had been taken (Trogmayer 1972, 73–74, fig. 2. 1, 4–7; Thissen 2000, 285). Knowing that Trogmayer dated the Gyálarét-Szilágyi-major site to the early Körös period (Trogmayer 1968b, 11, fig. 1; 1972, 75), it seems likely that the AVK sherds are unconnected to the Körös finds from the pit and the radiocarbon date.[42] Citing various typological arguments in support of the radiocarbon dates, such as the revision of the chronology of white-painted decoration and its assignment to the Karanovo II period, Thissen rejects Makkay's arguments concerning a parallel Körös-Starčevo development. He agrees with Milojčić's original proposal that the Körös culture should be synchronised with the late Starčevo period. He then goes on to draw the rather absurd conclusion that the classical Körös and the Protovinča phases were brief periods, which should be dated between 5600–5500 cal BC (Thissen 2000, 285). He cites Peter Breunig's study as supporting the parallelisation of the Körös culture with the late Starčevo period (Thissen 2000, 284–85).[43] Writing over a decade earlier, Breunig could hardly have known about the later correction of the radiocarbon measurements made in the British Museum laboratory (Bowman *et al.* 1990) and about the new dates available to Thissen, this being the reason that he believed that the late Starčevo and the Körös culture were coeval[44] and both dated to the earlier 5th millennium BC.[45] Breunig noted that the then available radiocarbon dates were insufficient for determining whether the entire Körös culture was co-eval with the late Starčevo phase as claimed by Milojčić or whether its development was more or less synchronous with the Starčevo culture, as asserted by Makkay (Breunig 1987, 134).[46] In sum we may say that Thissen's conclusions, based on a biased and selective handling of the evidence, are erroneous on several counts and therefore unacceptable.

Table 27.17. Radiocarbon chronology of the Criş culture after Biagi *et al.* 2005

Phase	BP	cal BC
Pre-Criş IA–IC	7200/7100–7000	6000–5900/5800
Criş IIA–IIB	7000–6900/6800	5900/5800–5800/5700
Criş IIIA	6900–6700	5800–5600
Criş IIIB	6800–6500	5700–5500

Even though samples from Hungary were not included, the publication of nineteen radiocarbon dates from inner Transylvania, the Romanian Banat and the Bačka is of relevance to the Hungarian Early Neolithic (Biagi *et al.* 2005). With the exception of one, the samples were collected on Romanian sites and the cultural attribution of the finds on typological grounds is known for each site, enabling the creation of an absolute chronological framework. The samples all come from periods preceding the Criş IV phase (except for one), and were thus suitable for establishing the absolute chronological brackets of these periods. The results are shown in *Table 27.17.*

The dates for the latest Starčevo, Körös and Criş sites harmonise neatly with the time span outlined by these measurements. The typology of the pottery finds and the radiocarbon dates for Cârcea-Viaduct and Deszk-Olajkút 1 both suggest that these sites can be assigned to a late phase.

In contrast to the model proposed by Horváth and Hertelendi, the scheme elaborated by Paolo Biagi and his colleagues allotted a period of 200/300 cal BC years to the Criş I–II period. The Criş III period lasted for 300 cal BC years, with an overlap of roughly one hundred years between individual phases and sub-phases (Biagi *et al.* 2005).[47] This is confirmed by the dates in *Table 27.18*, according to which the radiocarbon dates for secure Starčevo-Körös-Criş IV archaeological contexts fall between 5600–5300 cal BC, indicating a span of three hundred years for this period. This general picture, suggesting a broad time span for the late phases of these cultures (phases III and IV of the Starčevo, Körös and Criş cultures), fits in with Makkay's typological observations that many forms and decorative motifs, which are regarded as specific to the late Starčevo-Körös horizon, actually appeared in the second half of the classical Körös period (Makkay 1990b, 121).

Table 27.18. Absolute chronological position of the latest Starčevo, Körös and Criş phase

Phase	BP	cal BC
Starčevo-Körös-Criş IV	6650–6300	5600–5300

The beginning of the Vinča culture was put around 4500 uncal BC by John Chapman and Breunig (Chapman 1981, 31, 191, fig. 15; Breunig 1987, 109), which roughly corresponds to 5450/5400 cal BC. The earliest date for the Vinča-Bjelo Brdo site published by Schier is 6353±66 BP, corresponding to 5470–5260 cal BC (Hd-16661). Two samples from an earlier stratigraphic context at the eponymous site of Vinča could not be analysed owing to the low collagen content (Schier 1996, 149–150). Dates for the Vinča A phase in Hungary are available from Őszentiván VIII[48] (*Table 27.19*; Quitta and Kohl 1969, 244–245; Kohl and Quitta 1970, 411).

Four samples of the series published by Günther Kohl and Hans Quitta were taken from Pit VIII. The date of 5480–5320 cal BC (Bln-479) corresponds to the beginning of the Vinča A phase, while the date of 5320–5070 cal BC (Bln-477) falls partly into Vinča A and partly into Vinča B. The two other dates for the pit, 5210–4800 cal BC (Bln-478) and 5200–4800 cal BC (Bln-480) represent the second half of the Middle Neolithic and the onset of the Late Neolithic in Hungary. The fifth sample (Bln-476) came from a Late Copper Age Baden context and the date of 3360–3090 cal BC corresponds to that period. The combined radiocarbon age of the samples for the Vinča A phase is 6367±57 BP, corresponding to 5470–5290 cal BC (Bln-479, Bln-477).

The radiocarbon dates for Őszentiván later underwent a curious case of mistaken identities in the archaeological literature. Jan Lichardus re-published the two earliest dates in 1974 (based on Kohl and Quitta's study from 1970), but he mixed up the laboratory number of the 6460±80 BP date (Bln-479) with the laboratory number of the Late Copper Age sample (Lichardus 1974, 109). Although quoting Kohl and Quitta's 1970 study, Horváth and Hertelendi probably adopted this mistake from Lichardus' work in 1974; at the same time, they also cited the original sample (Bln-479) from Quitta and Kohl's first 1969 study, but with a higher standard deviation of twenty years (Horváth and Hertelendi 1994, 123), the outcome being that they 'gained' an extra very early Vinča date: 6460±100 BP, 5510–5310 cal BC which, however, had never existed.

The beginning of the Vinča culture cannot therefore be much earlier than 5450 cal BC. The radiocarbon dates for phase IV, the latest phase of the Starčevo, Körös, Criş assemblages, too suggest that it began around 5600 cal BC, before the emergence of the Vinča culture proper, although it must be borne in mind that the uncalibrated BP values of the dates between 5600 and 5480 cal BC fall closer to each other by 120 years owing to the wiggles of the calibration curve.

Table 27.19. The radiocarbon dates for the Őszentiván VIII site

Laboratory no.	Site	Feature	BP date	cal BC (68.2%)[49]	Reference
Bln-479	Őszentiván VIII	Pit VIII/e 2	6460±80	5480–5320	Quitta and Kohl 1969; Kohl and Quitta 1970
Bln-477	Őszentiván VIII	Pit VIII/e 4	6270±80	5320–5070	Quitta and Kohl 1969; Kohl and Quitta 1970
Bln-478	Őszentiván VIII	Pit VIII/e 5	6070±100	5210–4800	Quitta and Kohl 1969; Kohl and Quitta 1970
Bln-480	Őszentiván VIII	Pit VIII/e 3	6050±100	5200–4800	Quitta and Kohl 1969; Kohl and Quitta 1970
Bln-476	Őszentiván VIII	Pit I/a	4515±80	3360–3090	Quitta and Kohl 1969; Kohl and Quitta 1970

The contradiction is not entirely irresolvable. The periodisation proposed by Biagi and his colleagues and the date of 5700–5500 cal BC for Criş IIIB imply that this phase pre-dated the Vinča culture and does not support the contemporaneity of Starčevo IIIB and Vinča A1 in Lazarovici's chronological framework, which could only be confirmed if dates from Vinča A1 contexts of the Gornea/Felsőlupkó and Liubcova-Ornița/Alsólupkó sites were available and if these dates were older by 100–200 years than the currently known dates for Vinča A.

The typochronology and absolute chronology of the Early Neolithic finds from Ecsegfalva 23

Samples from the levels uncovered in the three trenches excavated at the Ecsegfalva 23 site were submitted for radiocarbon analyses to the Oxford Radiocarbon Accelerator Unit. The measurements indicated that Trench A could be dated to the early 5700s cal BC, and Trench B from the mid-5700s to the mid-5600s cal BC, with the overall time-span for the deposition apparently being less than a hundred and fifty years. The samples from Trench C were contemporaneous with the ones from Trench A and probably overlapped with the ones from Trench B. The occupation levels in Trench B spanned about seventy to eighty years. The models based on the radiocarbon dates thus indicate that the settlement's occupation spanned about three generations in the period between 5800/5750 and 5650 cal BC. The radiocarbon series obviously includes individual dates, whose sequence is in part earlier or later than this time bracket.

The site's chronological position as suggested by the radiocarbon dates harmonises with the one indicated by the typological analysis in that both reflect a relatively short occupation. The analysis of the ornamental motifs and the carinated forms did not reflect major stylistic changes during the settlement's life, and neither does the radiocarbon series include controversial dates or ones very far from each other.

A glance at the chronological scheme proposed by Biagi and his colleagues reveals that the period between 5800/5750 and 5650 cal BC suggested for the life-span of the Ecsegfalva settlement can be correlated with the Criş IIIA phase or perhaps even with the beginning of Criş IIIB. In Lazarovici's system, carinated forms first appear in the Starčevo IIIB phase, and are entirely lacking in the Starčevo IIIA phase with which the Ecsegfalva settlement is roughly parallel in terms of absolute chronology. The carination of the vessels of the Starčevo IIIB phase as defined by Lazarovici differs markedly from the sharply carinated wares of the ensuing period (Lazarovici 1979, pl. 7A. 5, 7B. 16, 7C. 27). The ceramic inventory from Ecsegfalva includes a few vessels with a sharp carination, which would allow a date in the later, Starčevo IVA period.

If the appearance of late Körös (Protovinča) traits can be attributed to successive waves of cultural impacts, which also stimulated the rise of the Vinča culture, it seems reasonable to assume that these traits – or at least some of them – appeared before the early Vinča culture. Accepting Dimitrijević's model based on the evidence from Croatian and Serbian sites, the appearance of earliest Vinča traits preceded the Starčevo Spiraloid B (Dimitrijević)–Starčevo IVA (Lazarovici)–Vinča A1 (Dimitrijević) period. If Lazarovici's model is accepted, according to which the emergence of the Vinča culture in the Romanian areas of the Banat pre-dated the culture's appearance in Serbia, the earliest Vinča traits preceded the Starčevo Spiraloid A (Dimitrijević)–Starčevo IIIB–Vinča A1 (Lazarovici) period. In the first case, the phase immediately preceding the Vinča A culture can be equated with Lazarovici's Starčevo-Criş IIIB, in the latter with the Starčevo-Criş IIIA, i.e. the period in which the new traits make their appearance. However, this does not resolve the contradiction that the radiocarbon dates for Ecsegfalva 23 suggest that the settlement is co-eval with Transylvanian and Banat sites, which – insofar as they have been correctly dated – represent a phase preceding the appearance of carinated and sharply carinated wares. In the lack of radiocarbon dates for Gornea/Felsőlupkó and Liubcova-Ornița/Alsólupkó, the absolute chronological dates for the various phases in Lazarovici's framework challenge the contemporaneity of Starčevo III with Vinča A1 in this system.

One could theoretically assume that the finds became mixed following the Körös occupation at Ecsegfalva, as a result of which a typologically later assemblage became mixed with the finds of a period predating the appearance of carinated wares and that the radiocarbon samples were taken from this earlier period. This possibility can be rejected on two counts. Firstly, a later AVK occupation overlies the Körös levels in Trench A and AVK sherds occurred but sporadically in the upper levels of Trench B. A large-scale mixing would have resulted in a random mixing of the Middle Neolithic finds with the latest Körös pottery. Secondly, if the finds of the latest Körös phase had become mixed with those of an earlier period, one might reasonably expect a few random dates between 5600 and 5300 cal BC representing the latest Körös phase among the radiocarbon measurements. The fact is that dates falling into the Starčevo-Criş IV range are missing from Ecsegfalva.

Summary

The Körös pottery recovered during the excavation is rather uniform typologically. It can be linked to a developmental period, in which the traits described by Makkay as typically Protovinča and by others as characterising the late Körös period already made their appearance. The best parallels to the ceramic assemblage can be quoted from late Körös (Protovinča sites) in Hungary and from Starčevo IVA assemblages in the Romanian Banat. In contrast, the radiocarbon dates indicate an occupation in the Starčevo IIIA or IIIA–IIIB period between 5800/5750–5650 cal BC, i.e. a period preceding the latest Körös and Starčevo phase.

The new radiocarbon measurements suggest that the period marked by assemblages assigned to the Starčevo-Criş III and Starčevo-Criş IV phase in regions lying south and south-east of Hungary spanned a longer time. From his typological analysis of the Körös pottery, Makkay concluded that certain Protovinča traits can be noted in the early and classical Körös assemblages. The appearance of carinated forms, burnishing, pattern burnishing and impressed decoration should thus be dated to a period preceding the latest Körös-Starčevo phase. The contemporaneity of the radiocarbon dates for Endrőd 119-Öregszőlők with those for Ecsegfalva 23 confirm this. The proportion of carinated wares among the pottery finds from Pit 3 of the Maroslele-Pana site, dated to the early Protovinča phase, and in the ceramic inventory from Tiszajenő-Szárazérpart, a site assigned to a phase pre-dating the Protovinča period, matches the frequency of carinated forms in the pottery from Trench B at Ecsegfalva.

The cultural attribution suggested by the typological traits of the pottery from Ecsegfalva 23 and the radiocarbon dates for the site cannot be fitted into the currently accepted chronological schemes. The internal periodisation of the Körös culture and the correlation of various pottery styles with the available radiocarbon dates seems as unattainable as the virtues of cleanliness and orderliness expected of the Körös population by Gyula Kisléghi Nagy. Three possible explanations can be cited for this deficiency:

1. Excavation methods are imperfect and the pottery finds from different periods cannot be reliably separated.
2. The radiocarbon measurements are still not precise enough to allow the determination of sub-phases.
3. The currently accepted relative chronological schemes need to be revised and refined.

In addition to the publication of still unpublished find assemblages, new advances in this respect can be hoped for from the precise observation and documentation of a settlement site's stratigraphy and new series of AMS dates based on samples from secure contexts. The combined study of layer sequences, pottery assemblages and radiocarbon series can contribute to the elaboration of a uniform chronological framework for the Körös culture. It remains to be seen whether future research projects will lead to the revision of the current typochronological systems.

It would appear that the horizon characterised by late Körös (Protovinča) traits spanned a longer period in the Early Neolithic of the central, southern and south-eastern regions of the Carpathian Basin. The archaeological record would suggest that sharply carinated wares appeared in the early phase of this period. Although beset by a number of uncertainties, a tentative solution to remedy this situation is presented in *Table 27.20.*

The first two columns show two possible periodisation schemes of the Körös culture; the third presents the sites probably assigned to a particular phase. Sites with calibrated dates from the early sixth millennium cal BC and/or whose finds included wares with white painted dot designs were assigned to the earliest phase (Körös I). The next phase (Körös II) is characterised by elements traditionally defined as representing the classical Körös period and the absence of carinated forms. According to Horváth and Hertelendi, the appearance of white on red painting in Hungary can be dated to around 5800 cal BC (Horváth and Hertelendi 1994, 112). If this is indeed the case, it is possible that the Körös I and II phases actually represent the same chronological horizon, whose absolute date corresponds to the Criş II phase. The implication of the latter is that the appearance of the Early Neolithic in the Körös distribution occurred a few generations later than in southern Transylvania and in the Starčevo heartland in Serbia. The third phase (Körös III) has a few carinated forms and stroke-burnished designs. The truly late assemblages (Körös IV) have carinated wares, pattern-burnished decoration, burnished wares, channelled patterns and channelled barbotine. Column 4 lists the accepted phases used in the regions beyond Hungary (correlated with the radiocarbon dates published by Biagi and his colleagues in 2005). Column 5 shows the dates published by Biagi and his colleagues (see above) and the framework based on the calibrated dates for the latest Starčevo, Körös and Criş sites. Column 6 presents the same framework without overlaps. In this system, the Early Neolithic assemblage from Ecsegfalva 23 can be assigned to the Körös III phase both on typological grounds and in view of the available radiocarbon dates. This model, however, does not eliminate the uncertainties in the relative and absolute chronology of the sites listed in *Table 27.20*, discussed above.

In his discussion of the Neolithic chronology of the Tisza region, Raczky proposed a four-fold division for the Körös culture (Raczky 1988, fig. 37). The model presented in *Table 27.20* incor-

Table 27.20. Correlation of traditional Körös phases with the available radiocarbon dates

Traditional Körös phases	Körös phases as defined by Raczky 1988	Sites possibly representing different Körös phases	Starčevo-Criş phases (after Lazarovici 1979; 1984; Biagi *et al.* 2005)	cal BC (after Biagi *et al.* 2005; Mantu 2000; Whittle *et al.* 2002)	Tentative outline for the different Criş and Körös phases in calendar years
Early Körös	Körös I	Gyálarét-Szilágyi major Szarvas 23	(Pre-)Criş IA–IC	6000–5900/5800	6000–5850
Classical Körös	Körös II	Röszke-Lúdvár, Pit 1	Starčevo-Criş II	5900/5800–5800/5700	5850–5750
Early Protovinča?	Körös III	Tiszajenő-Szárazérpart Szajol-Felsőföld Endrőd 119 Maroslele-Pana, Pit 3 (?) Ecsegfalva 23	Starčevo-Criş III	5800/5750–5600/5500	5750–5600
Late Körös/ Protovinča	Körös IV	Maroslele-Pana, Pit 3 (?) Deszk-Olajkút 1 (pits 8 and 15)	Starčevo-Criş IV	5600–5300	5600–5350

porates Makkay's observation that the so-called Protovinča traits can be noted from the second half of the classical Körös period (Makkay 1990b, 121). The absolute chronological position of the phases can be correlated with time brackets for various phases of the Criş culture as proposed by Biagi and his colleagues and it also fits in with Schier's assertion that the so-called Protovinča traits have nothing in common with Vinča A pottery (Schier 1997, 159), since they appeared much earlier than the onset of the Vinča A period. This chronological scheme is incompatible with Lazarovici's system, for the beginning of the Vinča culture can only be synchronised with the Starčevo-Körös IV period and the appearance of sharply carinated wares can be dated to the Starčevo-Körös-Criş III phase.

Notes

1 One of the earliest investigations of an Early Neolithic settlement in the Carpathian Basin was conducted at Óbesenyő by Gyula Kisléghi Nagy (1907; 1909; 1911). The village lying between Szeged and Timişoara (Temesvár/Temeschwar) is now part of Romania. Formerly called Óbessenyő in Hungarian, the village's Romanian name was initially Beşenova Veche, which was later changed to Dudeştii Vechi (by which name it now appears in the archaeological literature).

2 János Reizner re-published Pl. 2 from Ferenc Pulszky's 1882 article.

3 Writing about the prehistoric site at Békésszarvas (Szarvas-Szappanos), Ede Krecsmárik was generous with his praise for his pupils: "Three of my most enthusiastic pupils, Lajos Brózik, Pál Bribélszky and Mihály Palkovics, deserve to be mentioned here, and they are most certainly worthy of our admiration for they pursued the excavation and investigation untiringly, with great enthusiasm and curiosity from early morn to nightfall, shaming even the most hard-working day labourer." (Krecsmárik 1915, 11).

4 One advance in this respect will be the publication of Makkay's excavations in the Körös region (Makkay 2004, 20, note 38). Unfortunately, this publication did not appear before the closing of this manuscript on March 1, 2006.

5 I would here like to thank Eszter Bánffy, Ferenc Horváth, Nándor Kalicz and Tibor Marton for their help during the evaluation of the finds and their comments on the draft versions of the study. I am particularly indebted to Tibor Marton for preparing the illustrations.

6 Aside from two short visits to the site in 2000 and 2001, I was unable to participate in the excavation of the site.

7 The vessel bases here described as thickened bases or one of their variants are often labelled profiled bases in Hungarian archaeological literature, as in the description of the finds recovered from Pit 1 of the Kőtelek-Huszársarok site (Raczky 1983b, 166, and fig. 6. 9, 11). There is no sharp boundary between the sub-types, this being the reason that the label 'profiled base' was discarded in this study.

8 The site lies on the outskirts of Dudeştii Vechi/Óbesenyő (Romania).

9 Krecsmárik described this pattern as resembling a wheat spike.

10 *Schlickwurf* denotes a decorative technique, when the ceramic object is splashed with semi-liquid clay paste.

11 Raczky and Kalicz did not always distinguish between *Schlickwurf* and channelled barbotine.

12 The published finds clearly reveal that they meant channelled barbotine under '*Schlickwurf*'.

13 The field name 'Kapospart' was translated into German as *Kaposufer* in Kalicz's study written in German (Kalicz 1990).

14 "Deshalb ist unserer Ansicht nach zur Zeit die letzte Periode, die Periode des Erscheinens der ältesten Vinča-Elemente die einzig sichere innerhalb des Körös-Starčevo-Komplexes absonderbare Entwicklungsphase. Diese Periode nennen wir Protovinča-Periode." (Makkay 1969, 25).

15 The debates over the various designations of the Starčevo, Körös and Criş cultures will not be discussed here, and neither will their similarities and divergences, or their regional variants. The labels given by a particular author are followed when citing find assemblages, phases and theoretical models.

16 Although he did note that it might be possibly be co-eval with an earlier Starčevo phase (Milojčić 1949b, 265).

17 The name of the settlement, where two major Early Neolithic sites have been investigated (La Hanuri and Viaduct) is given as Cîrcea in earlier publications. Following the Romanian spelling reform in the 1990s, the name is now spelled as Cârcea, and it appears under this name in more recent Romanian studies (cf. Mantu 2000, 75–77, 98).

18 "und [Makkay] entwickelt das Modell mehrerer Wellen südlicher Impulse, deren früheste mit der Szatmár [I]-Phase zusammenfalle und in die zweite Hälfte der mittleren Körös-Periode zu datieren sei."

19 "The earliest general appearance of these Proto-Vinča traits (after their sporadic emergence in the early KS period) can be synchronised with the earliest, Szatmár, phase of the AVK in the second half of the middle KS period, preceding the late KS or Proto-Vinča phase." (Makkay 1990b, 121).

20 "Kategorie 1 ist die sog. *pattern burnish* - Verzierungsart. Hier laufen die feinen geglätteten/polierten Linien auf einer matt gebliebenen, geglätteten oder manchmal feinpolierten (burnished) Oberfläche. Diese Technik unterscheidet sich von der *impressed-Technik*, d.h. der mit eingeglätten/einpolierten Mustern, dadurch, daß die Linien nicht in die Oberfläche eingetieft sind: wenn man seine Finger auf der Oberfläche bewegt, dann fühlt man keine Tiefendifferenz." (Makkay 2000, 311).

21 "Die mit Einpolierung/Einglättung ausgeführten eingetieften (*impressed*) Linien (Kategorie 2, manchmal auch *stroke burnishing* genannt) bilden hingegen manchmal einfache Muster, die ohne Ausnahmen nur geometrisch sind und im allgemeinen um den Gefäßkörper herumlaufen." (Makkay 2000, 311).

22 "Die eingeritzten Linien (Kategorie 3) sind im allgemeinen mit einem spitzen feinen Werkzeug vor dem Brennen eingeschnitten bzw. eingezogen worden. Die Linien sind im Vergleich zu den solchen der Alföld Linienbandkeramik dünn und scharf und mit einem V-artigen Querschnitt." (Makkay 2000, 311).

23 Only one single pottery sherd (no. 101) could be assigned to this category from among the finds published by Makkay (Makkay 2000, 311, 325, Taf. 9).

24 "Echte Kannelierung (Kategorie 4) kommt selten vor, und nur in Befunden, die aufgrund von verschiedenen Überlegungen und Argumenten in eine späte, d. h. die sog. Protovinča Phase der Körös-Kultur datiert werden können." (Makkay 2000, 312). "Category 4" is obviously a misprint since it is the fifth decoration type listed by Makkay. His study describes 'incised after burning' decoration as the fourth category (Makkay 2000, 311).

25 The earliest, formative phase of the Transdanubian Linear Pottery preceding the Bicske–Bíňa/Bény horizon was identified by Eszter Bánffy on the basis of her excavations at Szentgyörgyvölgy-Pityerdomb (Bánffy 2000b; 2004).

26 The forthcoming volume mentioned in note 38 of this study (J. Makkay – E. Starnini: Excavations on Early Neolithic sites of the Körös culture in the Körös valley, Vol. I: The pottery assemblage) will no doubt contain much new information in this respect. The volume was still in print when this manuscript was closed.

27 Pl. 3 has two sherds numbered 18; at the same time, nos 20 and 21, described as coming from Maroslele-Pana, Pit 3 and Endrőd 6 resp. are not shown. The pottery sherds from Maroslele-Pana, Pit 3 can probably be identified with the three profile drawings shown under 18 and 19 and the unnumbered ones (Makkay 1990, 117, pl. 3).

28 The calibration of the individual, combined and sum radiocarbon dates presented in the tables and in the text was performed with version 3.9 of the OxCal calibration programme (Stuiver *et al.* 1998; Bronk Ramsey 2003) and they can thus be compared with each other. The calibrated calendar years are given with a 68.2% confidence level (1 sigma value). The calibrated radiocarbon date ranges for the phases distinguished in a particular chronological scheme follow the ones given by the author.

29 The roughly 470 archaeological samples submitted to the radiocarbon laboratory of the British Museum for dating between 1980 and 1984 were published with a systematic error due to a technical deficiency. Some of these samples came from the Endrőd 39-Szujókereszt and Szarvas 23-Egyházföld sites (Burleigh *et al.* 1983). Sheridan G. E. Bowman, Janet C. Ambers and M. N. Leese revised and re-published these measurements in 1990. The corrected dates were marked with the letter 'R' next to the original laboratory number, e.g. BM-1863R instead of BM-1863 (Bowman *et al.* 1990). *Table 27.14* shows both the original and the revised dates, but only the revised dates have been considered in the discussion below.

30 Cf. note 29.

31 Cf. note 29.

32 Cf. note 29.

33 Cf. note 29.

34 According to the study originally published in *Radiocarbon*, the sample came from Pit 1 in Trench VII (VII/I; Burleigh *et al.* 1983, 49), while according to Thissen, the pit in question was uncovered in Trench VIII (Thissen 2000, 286).

35 Cf. note 29.

36 "My dating of the Körös pottery types from Endrőd 119 to different phases of the entire Körös span simply means that typologically different wares of the Körös culture which are supposed to represent different phases of the culture were recovered from the pits and other settlement features of the Endrőd site."

In his publication of the animal bones from the site, Sándor Bökönyi quoted Makkay's personal communication that the settlement had been occupied throughout the Körös sequence, which he dated between 5000–4500 uncal BC. ("According to J. Makkay, the excavator of the site, the settlement was inhabited throughout the whole span of the Körös culture [Makkay, pers. comm.]. This would mean ca. 500 years [from about 5000 to 4500 years B.C.; uncalibrated C14 date]." Bökönyi 1992a, 237).

Makkay later claimed that he had never suggested this date to Bökönyi ("I never suggested such an inane date for the Endrőd 119 site either to Bökönyi, or to anybody else. This date was mere speculation on the late S. Bökönyi's part." Makkay 1996, 37, note 12).

37 Cf. note 29.

38 Cf. note 29.

39 The difference between the two combined dates can be explained by the inclusion of the Bln-582 date, which came from the same sample as the Bln-582a date.

40 "Because this date is known, and there is no question of inaccuracy, such an early phase of the Neolithic (monochrom?) in the Southern Alföld must be a reality." (Horváth and Hertelendi 1994, 112).

41 Cf. note 29.

42 This date is all the more problematic because it is based on a sample taken from a pottery fragment and because the ceramic inventory of the site remains mostly unknown. Quoting Horváth and Hertelendi (Horváth and Hertelendi 1994, 112), Trogmayer mentioned that a later phase of the Körös culture was also present at the site (Trogmayer 2004, 25, fig. 5. 5, 9, fig. 7. 6).

43 "Slightly earlier Breunig, after checking the Körös 14C evidence, had concluded that the period must date to 'late Starčevo' (Breunig 1987, 134)."

44 "Danach ist die zeitliche Parallelität von spätem Starčevo (siehe Kap. 2.6.) und Körös für die erste Hälfte des 5. Jahrtausends sicher belegt."

45 Uncalibrated date!

46 "Gegenwärtig ist aus der Sicht der 14C-Daten nicht zu entscheiden, ob Körös nur mit der Spätphase der Starčevo-Kultur (Milojčić 1949a; 1951) oder – entgegen dieser früheren Annahmen – größtenteils parallel zu Starčevo verläuft (Makkay 1969)."

47 The date ranges for each phase are based on three to four individual dates. It is to be expected that the inclusion of larger series will lead to a refinement of these broad intervals.

48 János Banner and Mihály Párducz, who published the finds from the site, introduced the name Banat culture for the early assemblages of the Vinča culture from the northern part of the Banat (Banner and Párducz 1948, 29), this being the reason that Quitta and Kohl described Pit VIII of the Ószentiván site as belonging to the 'Banater Gruppe' (Quitta and Kohl 1969, 245) or the 'Banat group' (Kohl and Quitta 1970, 411).

49 Cf. note 28.

Appendix

Description of the artefacts shown in the Figures

The illustrations are depictions of three-dimensional objects in perspective projection. The scales on the Figures are approximte only; exact measurements are to be found in the Appendix.

Fig. 27.1. Rounded and flat rims

1. Trench 23B, Context 443, Find no. 11949
Rim, neck and shoulder fragment of chaff-tempered vessel with light brown exterior and interior. The rim is rounded, the neck is cylindrical. The body is lightly polished.
H. 5 cm, W. 4.7 cm, Th. 0.4 cm

2. Trench 23B, Context 497, Find no. 14823
Rim and body fragment of a chaff-tempered vessel with light brown exterior and light brown-light grey interior. The rim is rounded. The body is lightly polished.
L. 5.8 cm, W. 3.8 cm, Th. 0.9 cm

3. Trench 23B, Context 340, Find no. 6374
Rim and body fragment of a chaff- and sand-tempered vessel with light brown exterior and interior. The rim is rounded.
H. 5.5 cm, W. 7.2 cm, Th. 0.8 cm

4. Trench 23B, Context 352, Find no. 7275
Rim and body fragment of a chaff- and sand-tempered vessel with grey exterior and interior. The rim is angular. The body is polished.
H. 7 cm, W. 9 cm, Th. 0.6 cm

5. Trench 23B, Context 443, Find no. 12086
Rim and body fragment of a chaff-tempered vessel with light brown-grey exterior and interior. The rim is angular. The body is lightly polished.
H. 4.1 cm, W. 4.2 cm, Th. 0.6 cm

6. Trench 23B, Context 439, Find no. 12054
Rim and body fragment of a chaff-tempered vessel with dark grey-light brown exterior. The rim is angular. The body and the interior are lightly polished.
H. 3 cm, W. 4.1 cm, Th. 0.5 cm

Fig. 27.2. Rims decorated with impressions

1. Trench 23B, Context 373, Find no. 8728
Rim, neck, and body fragment of a chaff-tempered vessel with light brown, grey mottled exterior and grey interior. The rim is decorated with impressions, the short neck is funnel-shaped.
L. 7.2 cm, W. 5.4 cm, Th. 0.8 cm

2. Trench 23B, Context 430, Find no. 11574
Rim, neck and shoulder fragment of a chaff-tempered vessel with light brown, grey mottled exterior and grey interior. The rim is decorated with finger impressions. The short neck is cylindrical, the shoulder has a pinched decoration.
L. 9.5 cm, W. 5.7 cm, Th. 0.7 cm

3. Trench 23B, Context 424, Find no. 12541
Rim, neck and shoulder fragment of a chaff-tempered vessel with light brown exterior and light brown and grey interior. The rim is decorated with finger impressions, the neck is outcurving.
L. 6.7 cm, W. 7.2 cm, Th. 0.8 cm

4. Trench 23B, Context 445, Find no. 12756
Rim, neck and body fragment of a chaff-tempered vessel with grey-light brown exterior and grey interior. The rim is decorated with nail impression, the body with pinched decoration. Joined from two fragments.
L. 9 cm, W. 10.5 cm, Th. 0.6 cm, dR. 17 cm

5. Trench 23B, Context 464, Find no. 14131
Rim fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. The rim is decorated with finger impressions.
L. 9.5 cm, W. 4.6 cm, Th. 1.3 cm

6. Trench 23B, Context 344, Find no. 6565
Rim, neck and shoulder fragment of chaff-tempered, globular vessel with light brown exterior and light brown, grey mottled interior. The rim is slightly thickened (splayed rim, *Lippenrand*), the short neck is outcurving.
L. 10.3 cm, W. 5.5 cm, Th. 0.8 cm, dR. 12 cm

Fig. 27.3. Thickened bases and pedestals

1. Trench 23B, Context 431, Find no. 11628
Body and base fragment of a chaff-tempered globular vessel with grey, brown mottled exterior and light brown-grey interior. The slightly concave base is of the less pronounced thickened variety.
H. 6.6 cm, W. 9 cm, Th. 0.3 cm, ThB. 0.9 cm, dB. 5.8 cm

2. Trench 23C, Context 520, Find no. 9400
Body and base fragment of a chaff-tempered vessel with light brown-light grey exterior and dark grey, light brown mottled interior. The slightly concave base is of the less pronounced thickened variety.
H. 1.9 cm, W. 7 cm, Th. 0.5 cm, dB. 4.1 cm

3. Trench 23A, Context 102, Find no. 1013
Body and base fragment of a chaff-tempered vessel with light brown exterior and interior. The thickened base is of the less pronounced variety.
H. 3.2 cm, W. 7.1 cm, Th. 0.4 cm, ThB. 1.6 cm, dB. 5 cm

4. Trench 23B, Context 301, Find no. 3716
Body and base fragment of a chaff-tempered vessel with light brown exterior and light brown, dark grey mottled interior. The body is decorated with a pinched pattern, the base is thickened.
H. 3.9 cm, W. 9.2 cm, Th. 1.5 cm, ThB. 1 cm, dB. 13.4 cm

5. Trench 23B, Context 430, Find no. 11390
Body and base fragment of a chaff-tempered vessel with light brown exterior and dark grey interior. The slightly concave base is thickened.
H. 3.4 cm, W. 10 cm, Th. 0.4 cm, ThB. 1.4 cm, dB. 8.6 cm

6. Trench 23B, Context 301, Find no. 3767
Body and base fragment of a chaff-tempered vessel with light brown exterior and interior. The base is thickened.
H. 5.6 cm, W. 11 cm, Th. 1.3 cm, ThB. 1.2 cm, dB. 11 cm

7. Trench 23B, Context 320/330/331, Find no. 5143
Solid pedestal fragment with dark grey and light brown exterior and interior tempered with chaff. The low pedestal is slightly conical, the base is flat.
H. 4.5 cm, Th. 0.5 cm, ThB 2.8 cm, dB. 6.3 cm

8. Trench 23B, Context 497, Find no. 14763
Pedestal fragment with light brown-dark grey exterior and interior tempered with chaff. The low, conical pedestal is lightly polished both on its exterior and interior and has a slightly concave base.
H. 8.7 cm, W. 13 cm, Th. 0.8 cm, dB. 12 cm

9. Trench 23B, Context 301, Find no. 3440
Pedestal fragment with dark grey, light brown mottled exterior and dark grey interior tempered with chaff. The low, conical pedestal has a slightly concave base.
H. 7.7 cm, W. 6.5 cm, Th. 1.1 cm, dB. 12.6 cm

Fig. 27.4. Pedestals

1. Trench 23B, Context 342, Find no. 6119
Pedestal fragment with light brown exterior and interior tempered with chaff. The low, conical pedestal is hollow and has a concave base.
H. 6.8 cm, W. 9.5 cm, Th. 1.1 cm, dB. 12 cm

2. Trench 23B, Context 430, Find no. 11601
Pedestal fragment with light brown-grey exterior and interior tempered with chaff. The low, conical pedestal is hollow and has a concave base.
H. 4.6 cm, W. 5.5 cm, Th. 0.6 cm, dB. 8 cm

3. Trench 23B, Context 301, Find no. 3420
Pedestal fragment with light brown-grey exterior and interior tempered with chaff. The low, conical pedestal is hollow and has a concave base. The interior is polished.
H. 5.6 cm, W. 9 cm, Th. 1.1 cm, ThP. 0.7 cm, dB. 9 cm

4. Trench 23B, Context 445, Find no. 13025
Pedestal fragment with light brown, grey mottled exterior and dark grey-light brown interior tempered with chaff. The low, conical pedestal is hollow and has a concave base. Joined from two fragments.
H. 5.2 cm, W. 8.1 cm, Th. 0.8 cm, ThP. 0.5 cm, dB. 7.3 cm

5. Trench 23B, Context 445, Find no. 12684
Pedestal fragment with dark grey, light brown mottled exterior and interior tempered with chaff. The low, conical pedestal is hollow and has a concave base.
H. 5.9 cm, W. 6 cm, Th. 0.6 cm, ThP. 0.8 cm, dB. 11 cm

6. Trench 23C, Context 526, Find no. 9454
Pedestal fragment with light brown exterior and light grey interior tempered with chaff. The low, conical pedestal is hollow and has a concave base. The exterior is lightly polished.
H. 7.2 cm, W. 8.5 cm, Th. 1.2 cm, ThP. 0.6 cm, dB. 12 cm

7. Trench 23B, Context 465, Find no. 13464
Pedestal fragment with light brown-grey exterior and dark grey interior tempered with chaff. The low, slightly conical, almost cylindrical pedestal is hollow and has a concave base.
H. 5.1 cm, W. 9 cm, Th. 1 cm, ThP. 0.6 cm, dB. 9.4 cm

8. Trench 23B, Context 465, Find no. 13497
Pedestal fragment from the junction with the vessel with light brown exterior and light brown, grey mottled interior tempered with chaff. The hollow pedestal has a small knob in the centre of the base. The exterior is decorated with a small knob.
H. 6.5 cm, W. 4.9 cm, Th. 1.2 cm

Fig. 27.5. Higher pedestals, flat bases and basal fragments of vessels standing on four feet

1. Trench 23A, Context 112, Find no. 1206
Pedestal fragment with light brown-grey exterior and grey interior tempered with chaff and sand. It is lightly polished.
H. 5.3 cm, W. 4.1 cm, Th. 0.8 cm, dB. 11 cm

2. Trench 23B, Context 300, Find no. 3037
Pedestal fragment with light brown, reddish-brown mottled exterior and light grey-light brown interior tempered with chaff.
H. 4 cm, W. 5.1 cm, ThB. 0.4 cm, dB. 7 cm

3. Trench 23B, Context 300, Find no. 3036
Pedestal fragment with light brown exterior and grey interior tempered with chaff.
H. 7.6 cm, W. 7.1 cm, ThB. 0.8 cm, dB. 7.4 cm

4. Trench 23B, Context 308, Find no. 4006
Flat base of a lightly polished, chaff- and sand-tempered vessel with grey exterior and interior. Joined from three fragments.
H. 2.8 cm, Th. 0.3 cm, dB. 5.3 cm

5. Trench 23C, Context 543, Find no. 9679
Flat base of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior.
H. 2.5 cm, W. 6.8 cm, Th. 0.5 cm, dB. 6.3 cm

6. Trench 23C, Context 537, Find no. 9646
Flat base of a chaff-tempered vessel with light brown exterior and grey interior.
H. 4.2 cm, W. 9.4 cm, Th. 0.5 cm, ThB. 1.3 cm, dB. 6.6 cm

7. Trench 23B, Context 430, Find no. 11402
Base and foot fragment of a chaff-tempered vessel set on four feet with grey exterior and interior. The low foot has an oval section.
H. 3.8 cm, W. 6 cm, Th. 0.8 cm, HF. 2.5 cm, dF. 1.8 cm

8. Trench 23B, Context 445, Find no. 12768
Base and foot fragment of a chaff-tempered vessel set on four feet with light brown, grey mottled exterior and grey interior. The low foot has an oval section. The vessel interior was lightly polished.
H. 3.8 cm, W. 6.1 cm, Th. 0.5 cm, HF. 1.8 cm, dF. 1.3 cm

Fig. 27.6. Basal fragments of vessels standing on four feet

1. Trench 23B, Context 343, Find no. 5808
Base and foot fragment of a chaff-tempered vessel set on four feet with light brown exterior and grey interior. The low foot has an oval section.
H. 4.8 cm, W. 10.2 cm, Th. 0.5 cm, HF. 2.5 cm, dF. 2.8 cm

2. Trench 23B, Context 424, Find no. 12212
Base and foot fragment of a chaff-tempered vessel set on four feet with greyish-brown exterior and grey interior. The low foot has an oval section. The vessel exterior was lightly polished.
H. 4.7 cm, W. 9 cm, Th. 1.1 cm, HF. 1.7 cm, dF. 3.5 cm

3. Trench 23B, Context 353, Find no. 6997
Base and foot fragment of a chaff- and sand-tempered vessel set on four feet with light grey-light brown exterior and interior. The two low feet have an oval section. The vessel interior is lightly polished.
H. 5.7 cm, W. 13.6 cm, Th. 0.8 cm, HF. 0.7 cm, WF. 2.5 cm

4. Trench 23B, Context 431, Find no. 11792
Base and foot fragment of a chaff-tempered, large vessel set on four feet with light brown, grey mottled exterior and dark grey-light brown interior. The low foot has an elongated oval section. The vessel body is decorated with a pinched pattern and a bipartite knob.
H. 10.5 cm, W. 15.5 cm, Th. 1.1 cm, HF. 3 cm, WF. 3.6 cm

5. Trench 23B, Context 445, Find no. 13187
Base and foot fragment of a chaff-tempered vessel set on four feet with light brown exterior and interior. The low foot has an oval section.
H. 6.6 cm, W. 6.8 cm, Th. 0.7 cm, HF. 2.5 cm, WF. 2.9 cm

6. Trench 23B, Context 351, Find no. 7167
Base and foot fragment of a chaff-tempered vessel with light brown exterior and interior. The low foot has an elongated oval section.
H. 3.2 cm, W. 5.5 cm, Th. 0.7 cm, HF. 0.7 cm, WF. 3.3 cm

Fig. 27.7. Vessel handles

1. Trench 23B, Context 464, Find no. 14139
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. A small handle is set on the body.
L. 9.5 cm, W. 5.2 cm, Th. 0.7 cm, dH. 1.4 cm, dH. 0.7 cm (inner)

2. Trench 23B, Context 482, Find no. 14547
Body fragment of a chaff-tempered vessel with light brown-grey exterior and grey interior. The interior is lightly polished. A small handle is set on the body.
L. 9.5 cm, W. 7 cm, Th. 0.7 cm, dH. 2 cm (inner)

3. Trench 23A, Context 107, Find no. 1097
Body fragment of a chaff-tempered vessel with light brown exterior and interior. A small handle is set on the body.
L. 6.4 cm, W. 6.4 cm, Th. 0.8 cm, dH. 2.3 cm (inner)

4. Trench 23B, Context 445, Find no. 12873
Body fragment of a chaff-tempered vessel with light brown exterior and grey, light brown mottled interior. A small handle is set on the body.
L. 9.1 cm, W. 6.9 cm, Th. 1 cm, dH. 1.8 cm (inner)

5. Trench 23B, Context 416, Find no. 13614
Small, light brown vessel handle tempered with chaff, decorated with a wide, finger-made groove.
dH. 2.3 cm (inner), ThH. 1.4 cm

6. Trench 23B, Context 354, Find no. 7594
Body fragment of a chaff-tempered vessel with light brown exterior and interior. A small handle is set on the body.
L. 10.7 cm, W. 7 cm, Th. 0.9 cm, dH. 1.7 cm (inner)

7. Trench 23B, Context 464, Find no. 14125
Body fragment of a chaff-tempered vessel with light brown-grey exterior and light brown interior. A small handle is set on the body.
L. 7.3 cm, W. 6.3 cm, Th. 0.9 cm, dH. 1.6 cm (inner)

8. Trench 23B, Context 464, Find no. 14127
Body fragment of a chaff-tempered vessel with light brown exterior and interior. A string-hole handle is set on the body.
L. 7.7 cm, W. 6.9 cm, Th. 0.6 cm, dH. 1.1 cm (inner)

9. Trench 23A, Context 123, Find no. 1269
Body and handle fragment of a chaff-tempered vessel with light brown exterior and interior. An elbow handle is set on the body. Joined from two fragments.
L. 5.2 cm, W. 4.1 cm, Th. 0.6 cm, dH. 1.3 cm (inner)

Fig. 27.8. Restored globular and conical bowls

1. Trench 23A, Context 112, Find no. 1206
Globular bowl with grey and light brown exterior and light brown, light grey mottled interior tempered with chaff. The rim is rounded, the base is thickened. Restored from its fragments.
H. 4.8 cm, Th. 0.5 cm, dR. 9.6 cm, dB. 4 cm

2. Trench 23B, Context 300, Find no. 3037
Globular bowl with light brown, grey mottled interior and light brown-light grey interior tempered with chaff. The rim is rounded, the base is flat. Assembled from its fragments.
H. 3.8 cm, Th. 0.5 cm, dR. 8.4 cm, dB. 3 cm,

3. Trench 23B, Context 327, Find no. 4808
Globular bowl with dark grey-light brown exterior and interior tempered with chaff. The rim is rounded, the base is thickened. Assembled from its fragments.
H. 4.2 cm, Th. 0.5 cm, dR. 9.5 cm, dB. 4.5 cm

4. Trench 23B, Context 300, Find no. 3037
Conical bowl with light brown exterior and interior tempered with chaff. The rim is rounded, the base is of the ringed variety. Assembled from its fragments.
H. 3.8 cm, Th. 0.6 cm, dR. 10 cm, dB. 4 cm

Fig. 27.9. Restored conical bowls and flowerpot-shaped vessel

1. Trench 23B, Context 442, Find no. 12585
Conical bowl with light brown-light grey exterior and interior tempered with chaff. The rim is rounded, the base is thickened. Assembled from its fragments.
H. 6.1 cm, Th. 0.5 cm, dR. 11.6 cm, dB. 5 cm

2. Trench 23B, Context 343, Find no. 6198
Conical bowl with light brown, grey mottled exterior and interior tempered with chaff. The rim is rounded, the base is of the ringed variety. Assembled from its fragments.
H. 4.2 cm, Th. 0.5 cm, dR. 7.6 cm, dB. 3.7 cm

3. Trench 23B, Context 423, Find no. 11129
Trench 23B, Context 423, Find no. 11136
Flowerpot-shaped, chaff-tempered vessel with grey-light brown exterior and interior. The rim is rounded, the vessel body above the carination is slightly curved, the lower part is conical, the base is thickened. Assembled from its fragments.
H. 7.2 cm, Th. 0.5 cm, dR. 12.2 cm, dB. 4.4 cm

Fig. 27.10. Fragments of globular bowls

1. Trench 23B, Context 422, Find no. 11095
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and light brown-grey interior. The rim is rounded. Joined from three fragments.
L. 13 cm, W. 11.4 cm, Th. 0.8 cm

2. Trench 23B, Context 301, Find no. 3180
Rim and body fragment of a chaff-tempered globular bowl with light brown, grey mottled exterior and interior. The rim is rounded.
L. 9.5 cm, W. 12 cm, Th. 0.8 cm, dR. 29 cm

3. Trench 23B, Context 457, Find no. 13275
Rim and body fragment of a chaff-tempered globular bowl with grey, light brown mottled exterior and interior. The rim is rounded.
L. 11 cm, W. 11 cm, Th. 1.1 cm, dR. 30 cm

4. Trench 23B, Context 301, Find no. 3762
Rim and body fragment of a chaff-tempered globular bowl with grey-light brown exterior and interior. The rim is rounded. Joined from two fragments.
L. 9.5 cm, W. 10 cm, Th. 0.7 cm

5. Trench 23C, Context –, Find no. 9008
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and interior. The rim is rounded. Joined from two fragments.
L. 8 cm, W. 10 cm, Th. 0.7 cm

6. Trench 23C, Context 521, Find no. 9419
Rim and body fragment of a chaff-tempered globular bowl with light brown-grey exterior and interior. The rim is rounded. The body is decorated with a knob.
L. 6.5 cm, W. 10.8 cm, Th. 0.6 cm, dR. 13 cm

7. Trench 23C, Context 512, Find no. 9314
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and interior. The rim is flat.
L. 5.7 cm, W. 4.8 cm, ThR. 0.6 cm

8. Trench 23B, Context 317, Find no. 4441
Rim and body fragment of a chaff-tempered globular bowl with brown, grey mottled exterior and dark grey, lightly polished interior. The rim is flat. The body is decorated with a knob. Joined from four fragments.
L. 8 cm, W. 17.4 cm, Th. 0.7 cm, dR. 23.2 cm

Fig. 27.11. Fragments of globular and conical bowls

1. Trench 23B, Context 445, Find no. 12808
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and light brown-light grey interior. The rim is decorated with finger impressions.
H. 8 cm, W. 10 cm, Th. 1.8 cm, dR. 32 cm

2. Trench 23B, Context 445, Find no. 12999
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and light grey-light brown interior. The rim is decorated with finger impressions. Joined from four fragments.
H. 9.8 cm, W. 12 cm, Th. 1.2 cm

3. Trench 23B, Context 457, Find no. 13305
Rim and body fragment of a chaff- and sand-tempered deep bowl with dark grey-brown exterior and interior. The rim is flat, the body is polished. Joined from two fragments.
H. 10.3 cm, W. 9 cm, Th. 0.7 cm, dR. 33 cm

4. Trench 23B, Context 603, Find no. 14841
Rim and body fragment of a chaff- and sand-tempered conical bowl with dark grey exterior and dark grey-light brown interior. The rim is rounded. The body is polished.
H. 6.3 cm, W. 9.7 cm, Th. 0.8 cm, dR. 37 cm

5. Trench 23B, Context 445, Find no. 13193
Rim and body fragment of a chaff- and sand-tempered conical bowl with grey-light brown exterior and dark grey-light brown, lightly polished interior. The rim is rounded.
H. 7.7 cm, W. 13.5 cm, Th. 0.9 cm, dR. 34 cm

6. Trench 23B, Context 357, Find no. 7669
Rim and body fragment of a chaff- and sand-tempered conical bowl with dark grey, light brown mottled, polished exterior and interior. The rim is rounded.
H. 7.5 cm, W. 9.3 cm, Th. 0.8 cm, dR. 36 cm

Fig. 27.12. Fragments of large conical and carinated bowls

1. Trench 23B, Context 445, Find no. 13186
Rim and body fragment of a large, chaff-tempered, conical bowl with light brown exterior and light brown, grey mottled interior. The rim is decorated with finger impressions.
L. 15.5 cm, W. 10.5 cm, Th. 1.2 cm

2. Trench 23B, Context 464, Find no. 14197
Rim and body fragment of a large, chaff-tempered, slightly carinated bowl with light brown exterior and greyish-brown interior. The rim is decorated with finger impressions, the body with a pinched pattern resembling a sparse spike motif.
L. 16 cm, W. 13.5 cm, Th. 1.3 cm

3. Trench 23B, Context 424, Find no. 12247
Rim and body fragment of a large, chaff-tempered, conical bowl with light brown exterior and grey, light brown mottled interior. The rim is decorated with finger impressions, the body with applied barbotine. Joined from two fragments.
L. 18 cm, W. 13.2 cm, Th. 1.3 cm

4. Trench 23C, Context 501, Find no. 9007
Rim and body fragment of a large, chaff-tempered, conical bowl with reddish-brown exterior and interior. The rim is slightly swollen and decorated with finger impressions. It appears to have been secondarily burnt.
L. 13 cm, W. 11.5 cm, Th. 1.7 cm

Fig. 27.13. Bowls with cylindrical upper part

1. Trench 23B, Context 430, Find no. 11343
Bowl with grey-light brown exterior and grey interior tempered with chaff. The rim is rounded. The vessel body above the carination is cylindrical, the lower part is conical. The slightly concave base is thickened. A knob is set on the carination. Assembled from its fragments.
H. 15.7 cm, Th. 0.9 cm, dR. 26.5 cm, dB. 9.5 cm

2. Trench 23B, Context 430, Find no. 11345
Trench 23B, Context 430, Find no. 11363
Trench 23B, Context 464, Find no. 14146
Bowl with grey-light brown exterior and interior tempered with chaff. The rim is rounded. The vessel body above the carination is cylindrical, the lower part is conical. The slightly concave base is thickened. Assembled from its fragments.
H. 8.8 cm, Th. 0.6 cm, dR. 15.2 cm, dB. 5.8 cm

Fig. 27.14. Carinated bowls

1. Trench 23B, Context 311, Find no. 4117
Biconical bowl with light brown exterior and interior tempered with chaff. The rim is rounded. The vessel body above the carination is smaller than the lower part. The base is thickened. Assembled from its fragments.
H. 6.7 cm, Th. 0.6 cm, dR. 10.5 cm, dB. 4 cm

2. Trench 23B, Context 330, Find no. 4886
Biconical bowl with light brown-light grey exterior and interior tempered with chaff. The rim is rounded. The vessel body above the carination is smaller than the lower part. The base is flat. An oval knob is set on the carination; the vessel had originally been decorated with three evenly spaced knobs. Assembled from its fragments.
H. 6.6 cm, Th. 0.6 cm, dR. 14.3 cm, dB. 4.5 cm

3. Trench 23C, Context 535, Find no. 9638
Biconical bowl with light brown-light grey exterior and interior tempered with chaff. The rim is rounded, the base is thickened. Assembled from its fragments.
H. 5.4 cm, Th. 0.7 cm, dR. 12.7 cm, dB. 5.2 cm

Fig. 27.15. Fragments of carinated bowls

1. Trench 23B, Context 302, Find no. 3025
Rim and body fragment of a chaff-tempered deep bowl with dark grey-light grey exterior and grey, light brown mottled interior. The rim is rounded. The vessel body above the carination is cylindrical, the lower part is conical.
H. 7.5 cm, W. 8 cm, Th. 0.6 cm

2. Trench 23B, Context 340/352, Find no. 6887
Rim and body fragment of a chaff-tempered deep bowl with grey-light brown exterior and light brown interior. The rim is rounded. The vessel body above the carination is cylindrical and slightly incurving, the lower part is conical.
H. 6.7 cm, W. 7.7 cm, Th. 0.6 cm, dR. 14 cm

3. Trench 23B, Context 457, Find no. 13229
Rim and body fragment of a deep, chaff-tempered bowl with dark grey exterior and interior. The rounded rim is thickened. The vessel body above the carination is cylindrical and slightly incurving, the lower part is conical. The interior is lightly polished.
H. 7.4 cm, W. 6.8 cm, Th. 0.5 cm, dR. 14 cm

4. Trench 23B, Context 445, Find no. 12768
Rim and body sherd of a deep, chaff-tempered bowl with light brown-light grey exterior and light brown interior. The rim is rounded. The vessel body above the carination is flared, the lower part is conical. A rib decorated with finger impressions is set on the sharp carination.
H. 5.7 cm, W. 6.2 cm, Th. 0.7 cm

5. Trench 23B, Context 443, Find no. 12039
Rim and body sherd of a chaff-tempered, sharply carinated bowl with light brown-grey exterior and light brown interior. The rim is rounded. The vessel body above the carination is almost cylindrical, the lower part is conical.
H. 2 cm, W. 3.8 cm, Th. 0.4 cm, dR. 5 cm

6. Trench 23B, Context 430, Find no. 11842
Rim and body fragment of a chaff-tempered, sharply carinated biconical bowl with light brown-grey exterior and interior. The rim is rounded.
H. 2.7 cm, W. 3.8 cm, Th. 0.7 cm, dR. 10 cm

7. Trench 23B, Context 371, Find no. 8777
Rim and body fragment of a chaff- and sand-tempered, lightly polished, sharply carinated biconical bowl with grey-light brown exterior and light brown interior. The rim is rounded.
H. 4.3 cm, W. 5.3 cm, Th. 0.5 cm

Fig. 27.16. Fragments of carinated bowls

1. Trench 23A, Context 112, Find no. 1206
Rim and body fragment of a chaff-tempered, sharply carinated, deep bowl with light grey-light brown exterior and light brown interior. The vessel body above the carination is slightly incurving, almost cylindrical, the lower part is conical. Joined from two fragments.
H. 6.2 cm, W. 8.5 cm, Th. 0.7 cm, dR. 16 cm

2. Trench 23B, Context 415, Find no. 10724
Body fragment of a chaff- and sand-tempered biconical bowl with grey exterior and grey-light brown interior. An oval knob is set on the sharp carination. The vessel body is lightly polished.
L. 7 cm, W. 4.7 cm, Th. 0.9 cm

3. Trench 23C, Context 507, Find no. 9123
Body sherd of a chaff-tempered biconical bowl with light grey-dark grey exterior and light brown interior. An oval knob is set on the sharp carination.
L. 4.8 cm, W. 3 cm, Th. 0.5 cm

4. Trench 23C, Context 535, Find no. 9638
Rim and body sherd of a chaff-tempered deep bowl with light brown exterior and interior. The rim is flat. The vessel body above the carination is cylindrical, the lower part is conical. An oval knob is set on the sharp carination.
L. 5 cm, W. 4.5 cm, Th. 0.8 cm

5. Trench 23B, Context 311, Find no. 4118
Rim and body fragment of a chaff- and sand-tempered biconical bowl with dark grey exterior and interior. The rim is rounded. An oval knob is set on the sharp carination.
H. 3.1 cm, W. 2.8 cm, Th. 0.6 cm

6. Trench 23B, Context 383, Find no. 10164
Rim and body fragment of a chaff-tempered deep bowl with dark grey exterior and interior. The vessel body above the carination is near cylindrical, slightly incurving, the lower part is conical. An oval knob is set on the sharp carination. The vessel is polished on both the exterior and interior.
H. 5.9 cm, W. 7.4 cm, Th. 0.6 cm, dR. 16 cm

Fig. 27.17. Fragments of carinated bowls

1. Trench 23B, Context 340, Find no. 6865
Rim, neck and body fragment of a chaff- and sand-tempered biconical bowl with grey, light brown mottled exterior and interior. The rounded rim is thickened, the neck is angular. A bipartite knob is set on the carination. Joined from two pieces.
H. 5 cm, W. 8.2 cm, Th. 0.7 cm, dR. 12 cm

2. Trench 23B, Context 383, Find no. 8931
Rim, neck and shoulder fragment of a chaff-tempered biconical bowl with greyish-brown exterior and interior. The flat rim is thickened, the neck is slightly curved. A knob is set on the sharp carination. The vessel body is lightly polished.
H. 3.9 cm, W. 4.7 cm, Th. 0.5 cm, dR. 21 cm

3. Trench 23B, Context 317, Find no. 4429
Rim, neck and body fragment of a chaff-tempered biconical bowl with brown-brick red exterior and brown interior. The rounded rim is thickened, the neck is angular. The sharply carinated vessel body is polished on both the exterior and interior.
H. 3.6 cm, W. 5 cm, Th. 0.6 cm, dR. 19 cm

4. Trench 23C, Context 507, Find no. 9117
Rim, neck and body fragment of a chaff-tempered, sharply carinated biconical bowl with greyish-brown exterior and grey interior. The rounded rim is thickened, the neck is angular.
H. 3.5 cm, W. 5.3 cm, Th. 0.5 cm

5. Trench 23C, Context 507, Find no. 9111
Rim, neck and body fragment of a chaff-tempered, sharply carinated biconical bowl with light brown exterior and interior. The rounded rim is thickened, the neck is angular.
H. 6.1 cm, W. 5.4 cm, Th. 0.6 cm

6. Trench 23B, Context 422, Find no. 11095
Rim, neck and shoulder fragment of a chaff-tempered, sharply carinated biconical bowl with grey-light brown exterior and light grey, light brown mottled interior. The flat rim is thickened, the neck is slightly curved.
H. 4.8 cm, W. 4.4 cm, Th. 0.5 cm, dR. 11 cm

7. Trench 23B, Context 430, Find no. 11616
Rim, neck and body fragment of a chaff-tempered, sharply carinated biconical bowl with dark grey-light brown exterior and interior. The flat rim is thickened, the neck is slightly curved.
H. 4.5 cm, W. 5.9 cm, Th. 0.5 cm

Fig. 27.18. Fragments of carinated bowls

1. Trench 23B, Context 445, Find no. 12993
Rim and body fragment of a chaff-tempered biconical bowl with reddish-brown exterior and light brown interior. The rim is rounded.
H. 6.4 cm, W. 3.5 cm, Th. 0.4 cm

2. Trench 23B, Context 445, Find no. 12993
Body fragment of a chaff-tempered biconical bowl with light brown exterior and dark grey, polished interior.
L. 6.5 cm, W. 5.7 cm, Th. 0.6 cm

3. Trench 23B, Context 422, Find no. 11008
Body fragment of a chaff- and sand-tempered, sharply carinated biconical bowl with light brown-dark grey exterior and dark grey interior.
L. 4.4 cm, W. 4.3 cm, Th. 0.7 cm

4. Trench 23B, Context 423, Find no. 11150
Body fragment of a chaff-tempered, sharply carinated bowl with light brown exterior and dark grey interior. The vessel body above the carination is flared.
L. 4.5 cm, W. 3.7 cm, Th. 0.5 cm

5. Trench 23B, Context 301, Find no. 3545
Body sherd of a chaff-tempered biconical bowl with light brown-dark grey exterior and dark grey interior.
L. 8.1 cm, W. 7.4 cm, Th. 0.6 cm

6. Trench 23B, Context 445, Find no. 13000
Rim and body fragment of a chaff-tempered, sharply carinated biconical bowl with dark grey, light brown mottled exterior and interior. The rim is rounded, the vessel body above the carination is slightly curved and flared. The interior is lightly polished. Joined from two fragments.
H. 7.8 cm, W. 7.2 cm, Th. 0.6 cm, dR. 21 cm

7. Trench 23B, Context 300, Find no. 3281
Rim and body fragment of a chaff-tempered biconical bowl with light brown, grey mottled exterior and light brown interior. The rim is rounded. The vessel body above the carination is flared, the lower part is conical. An oval knob is set on the sharp carination.
H. 8 cm, W. 8.8 cm, Th. 0.8 cm, dR. 17 cm

8. Trench 23A, Context 112, Find no. 1206
Rim and body fragment of a chaff-tempered, sharply carinated biconical bowl with light brown-light grey exterior and interior. The rim is rounded. The vessel body above the carination is flared, the lower part is conical. Joined from two fragments.
H. 6 cm, W. 9.7 cm, Th. 0.6 cm

Fig. 27.19. Bowl and bowl fragments with an S profile

1. Trench 23B, Context 301, Find no. 3470
Chaff-tempered, S-profiled deep bowl with greyish-brown exterior and light brown interior. The rim is flat, the short neck is slightly funnel-shaped, the concave base is thickened. The vessel body is polished. Assembled from its fragments.
H. 9.5 cm, Th. 0.5 cm, dR. 11.6 cm, dB. 5.7 cm

2. Trench 23B, Context 424, Find no. 12225
Rim, neck and body fragment of a chaff-tempered, S-profiled deep bowl with grey, brown mottled exterior and interior. The rim is thinned.
H. 9 cm, W. 13.5 cm, Th. 0.7 cm, dR. 16 cm

3. Trench 23B, Context 464, Find no. 14164
Rim, neck and body fragment of a chaff-tempered, S-profiled deep bowl with light brown exterior and interior. The rim is flat. The vessel body is polished.
H. 10 cm, W. 8.3 cm, Th. 0.6 cm, dR. 16 cm

4. Trench 23B, Context 344, Find no. 6503
Rim, neck and shoulder fragment of a chaff-tempered, S-profiled deep bowl with grey exterior and interior. The rim is rounded.
H. 8.3 cm, W. 6 cm, Th. 0.5 cm

5. Trench 23B, Context 464, Find no. 14072
Rim, neck and body fragment of a chaff-tempered, S-profiled deep bowl with light brown exterior and grey interior. The rim is thinned.
H. 6.4 cm, W. 4 cm, Th. 0.6 cm, dR. 15 cm

Fig. 27.20. Cups and fragments of handled cups

1. Trench 23B, Context 343, Find no. 6219
Chaff-tempered conical cup with reddish-brown and grey exterior and interior. The vessel body is polished. Assembled from its fragments.
H. 5.3 cm, Th. 0.5 cm, dR. 6.4 cm, dB. 4.2 cm

2. Trench 23B, Context 344, Find no. 6579
Chaff-tempered semi-spherical cup with light brown-grey exterior and interior. Assembled from its fragments.
H. 6 cm, Th. 0.7 cm, dR. 7.9 cm, dB. 4.2 cm

3. Trench 23B, Context 424, Find no. 12248
Body and base fragment of a chaff-tempered, handled cup with grey exterior and interior. The base is flat. The stub is all that remains of the handle.
H. 3 cm, W. 5.5 cm, Th. 0.7 cm

4. Trench 23B, Context 445, Find no. 12752
Body and base fragment of a chaff-tempered, one-handled cup with greyish-brown exterior and interior. The base is thickened. The stub is all that remains of the handle.
H. 3.7 cm, W. 7 cm, Th. 0.4 cm, dB. 5.3 cm

5. Trench 23B, Context 344, Find no. 5973
Fragment of a light brown, chaff-tempered, lightly polished handle with oval section. It probably comes from a handled cup.
L. 5.5 cm

6. Trench 23B, Context 445, Find no. 13043
Fragment of a light brown, grey mottled, chaff-tempered handle with oval section. It probably comes from a one-handled cup.
L. 6.4 cm, dH. 2.8 cm (inner)

7. Trench 23B, Context 431/440, Find no. 11461
Fragment of a light brown, chaff-tempered handle with oval section. It probably comes from a one-handled cup.
L. 8.2 cm

8. Trench 23A, Context 113, Find no. 1225
Fragment of a light brown, chaff-tempered handle with oval section. It probably comes from a one-handled cup.
L. 7.1 cm

Fig. 27.21. Restored mug, globular vessel and fragments of globular vessels

1. Trench 23B, Context 430, Find no. 11356
   Trench 23B, Context 430, Find no. 11374
   Trench 23B, Context 445, Find no. 12845
Chaff-tempered mug with light brown, grey mottled exterior and interior. The rim is flat, the neck is cylindrical, the body is biconical. The vessel body is polished. Assembled from its fragments.
H. 8.5 cm, Th. 0.5 cm, dR. 8 cm, dB. 4.7 cm

2. Trench 23B, Context 376, Find no. 8965
Chaff-tempered globular bowl with light brown exterior and interior. The rim is decorated with twig impressions. The short neck is cylindrical, the base is thickened. The vessel body is covered with pinched decoration and a barbotine-like knob is set under the carination. Assembled from its fragments.
H. 12.7 cm, Th. 0.5 cm, dR. 10.6 cm, dB. 7.4 cm

3. Trench 23B, Context 423, Find no. 11150
   Trench 23B, Context 431, Find no. 11802
   Trench 23B, Context 457, Find no. 13291
Rim, shoulder and body fragment of a chaff-tempered globular vessel with light brown, grey mottled exterior and light brown interior. The rim is decorated with impressions, the short neck is outcurving. The shoulder and the body are decorated with incised pairs of lines and an obliquely set rib with impressions. Joined from three fragments.
H. 7.5 cm, Th. 0.4 cm, dR. 12 cm

4. Trench 23B, Context 445, Find no. 13001
Rim, shoulder and body fragment of a chaff-tempered globular vessel with light brown exterior and grey interior. The rim is decorated with finger impressions.
H. 7.4 cm, W. 9.7 cm, Th. 0.5 cm, dR. 13 cm

5. Trench 23C, Context 521, Find no. 9414
Rim, neck and body fragment of a globular vessel with brownish-grey exterior and light brown interior. The rounded rim is decorated with finger impressions, the neck is outcurving. An impressed knob is set on the shoulder. Joined from three fragments.
H. 8.3 cm, W. 9 cm, Th. 0.9 cm, dR. 14 cm

Fig. 27.22. Fragments of globular vessels

1. Trench 23B, Context 457, Find no. 13255
Rim, neck and body fragment of a chaff-tempered vessel with grey exterior and grey-light brown interior. The rim is rounded, the short neck is cylindrical. A small handle is set on the shoulder. Joined from two fragments.
H. 7.7 cm, W. 12.5 cm, Th. 0.4 cm, dR. 11.4 cm, dH. 0.8 cm (inner)

2. Trench 23C, Context 509, Find no. 9195
Rim, neck and body fragment of a chaff-tempered globular vessel with greyish-brown exterior and grey interior. The rim is rounded, the neck is cylindrical.
H. 2.9 cm, W. 4.2 cm, Th. 0.4 cm, dR. 6 cm

3. Trench 23C, Context 512, Find no. 9327
Rim and body fragment of a chaff-tempered globular bowl with light brown exterior and light brown-light grey interior. The thickened rim is decorated with finger impressions. The vessel body is lightly polished.
H. 7.5 cm, W. 6.8 cm, Th. 0.7 cm

4. Trench 23B, Context 435, Find no. 11383
Rim, neck and body fragment of a chaff-tempered globular vessel with light brown exterior and greyish-brown interior. The rim is decorated with finger impressions, the neck is cylindrical. Joined from two fragments.
H. 6.2 cm, W. 7 cm, Th. 0.6 cm

5. Trench 23C, Context 529, Find no. 9519
Rim and body fragment of a chaff-tempered globular vessel with light brown, grey mottled exterior and brown-grey interior. The rim is flat. The vessel body is decorated with a plain and an impressed knob.
H. 11.2 cm, W. 9.3 cm, Th. 0.5 cm, dR. 15 cm

6. Trench 23B, Context 443, Find no. 11955
Rim, neck and body fragment of a chaff-tempered globular vessel with light brown, grey mottled exterior and dark grey-greyish-brown interior. The rim is decorated with finger impressions, the short neck is cylindrical. A double knob is set on the vessel body.
H. 6.6 cm, W. 5.5 cm, Th. 1 cm

7. Trench 23B, Context 431/440, Find no. 13592
Rim and body fragment of a chaff-tempered globular vessel with light brown exterior and interior. The rounded rim is slightly thickened.
H. 7.5 cm, W. 7.2 cm, Th. 0.8 cm, dR. 10 cm

Fig. 27.23. Fragments of globular vessels

1. Trench 23B, Context 464, Find no. 14301
Rim, neck and body fragment of a chaff and sand-tempered globular vessel with light brown, grey mottled exterior and interior. The everted rim is decorated with finger impressions. The vessel body is lightly polished and covered with a pinched spike pattern.
H. 11.7 cm, W. 10 cm, Th. 1.2 cm

2. Trench 23B, Context 316, Find no. 4593
Body and base fragment of a chaff-tempered globular vessel with light brown, grey mottled exterior and interior. The base is thickened. The vessel body is covered with pinched decoration and an impressed knob is set on it. Joined from five fragments.
H. 9.5 cm, W. 12.5 cm, Th. 0.8 cm, dB. 9.5 cm

3. Trench 23C, Context 526, Find no. 9453
Body and base fragment of a chaff-tempered globular vessel with light brown exterior and grey interior. The base is thickened. The lightly polished vessel body is covered with a pinched pattern. Joined from two fragments.
H. 7.5 cm, W. 11 cm, Th. 0.5 cm, dB. 11.5 cm

4. Trench 23B, Context 344, Find no. 6438
Trench 23B, Context 354, Find no. 8324
Body and base fragment of a chaff-tempered globular vessel with light brown exterior and light brown, grey mottled interior. The base is thickened. The vessel body is covered with barbotine decoration. Joined from five fragments.
H. 13.8 cm, Th. 1.1 cm, dB. 13 cm

Fig. 27.24. Restored flattened globular vessel, fragments of globular and flattened globular vessels

1. Trench 23C, Context 521, Find no. 9420
Body and base fragment of a chaff- and sand-tempered globular vessel with light grey exterior and dark grey interior. The concave base is thickened. Joined from three fragments.
H. 11.5 cm, W. 13.3 cm, Th. 0.6 cm, dB. 8 cm

2. Trench 23B, Context 430, Find no. 11266
Trench 23B, Context 464, Find no. 14374
Trench 23B, Context 445, Find no. 14820
Trench 23B, Context 497, Find no. 14823
Chaff-tempered flattened globular vessel with grey-light brown exterior and interior set on four feet. The rim of this thin-walled vessel is rounded, the neck is funnel-shaped, the body is globular, the base is curved. It seems likely that the vessel was set on four small feet with oval section, of which the stubs are all that remain. Two horizontal handles were set on the shoulder, but only has remains. The vessel body above the carination is covered with a stroke-burnished lattice and herringbone pattern arranged in panels. Assembled from its fragments.
H. 11.7 cm, Th. 0.5 cm, dR. 9.2 cm, dH. 0.7 cm (inner)

3. Trench 23B, Context 424, Find no. 12507
Rim, neck and body fragment of a flattened globular vessel with brownish-grey exterior and light brown interior. The rim is rounded, the short neck is funnel-shaped. A divided knob is set on the carination. Joined from two fragments.
H. 9.8 cm, W. 11.3 cm, Th. 0.6 cm, dR. 13.4 cm

Fig. 27.25. Fragments of storage jars

1. Trench 23B, Context 457, Find no. 13234
Trench 23B, Context 464, Find no. 14378
Rim and body fragment of a chaff-tempered barrel-shaped storage jar (or deep bowl) with light brown-grey exterior and greyish brown interior. The rim is decorated with finger impressions. The body is decorated with pinched spike motifs, incised pairs of lines, and a finger-impressed double knob. Joined from six fragments.
H. 25.2 cm, W. 23.4 cm, Th. 17 cm, dR. 36 cm

2. Trench 23B, Context 445, Find no. 13026
Rim, neck and body fragment of a large, chaff-tempered, globular storage jar with light brown, grey mottled exterior and light brown interior. The rim is rounded, the short neck is cylindrical. The vessel body is decorated with a flat, disc-like knob and applied barbotine. Joined from six fragments.
H. 19.5 cm, W. 16 cm, Th. 1.2 cm

3. Trench 23B, Context 431, Find no. 11781
Body fragment of a large, chaff-tempered, globular storage jar with light brown exterior and interior. The vessel body is covered with mussel impressions and incised pairs of lines. Joined from two fragments.
H. 25 cm, W. 21.4 cm, Th. 1.1 cm

Fig. 27.26. Fragments of storage jars

1. Trench 23B, Context 493, Find no. 14730
Rim, neck and shoulder fragment of a large, chaff-tempered storage jar with light brown exterior and interior. The rim is rounded, the short neck is everted. A row of knobs encircles the neck at the junction of the neck and the vessel body.
H. 10.8 cm, W. 15.6 cm, Th. 1 cm

2. Trench 23B, Context 464, Find no. 14198
Rim and neck fragment of a large, chaff-tempered storage jar with light brown exterior and interior. The rounded rim is decorated with finger impressions. The short neck is funnel-shaped. A row of knobs encircles the neck at the junction of the neck and the vessel body.
H. 8.2 cm, W. 15.2 cm, Th. 1.2 cm

3. Trench 23B, Context 430, Find no. 11609
Rim, neck and shoulder fragment of a large, chaff-tempered storage jar with light brown exterior and interior. The rim is rounded, the short neck is cylindrical. A pair of knobs is set on the shoulder. Joined from four fragments.
H. 12.7 cm, W. 23.5 cm, Th. 1.7 cm

4. Trench 23B, Context 405, Find no. 10618
Body fragment of a large, chaff-tempered storage jar with brick red exterior and interior. The body is decorated with a finger-impressed rib and impressed knobs. Secondarily burnt.
L. 15.8 cm, W. 10 cm, Th. 2.5 cm

5. Trench 23B, Context 327, Find no. 5081
Body fragment of a large, chaff-tempered storage jar with dark grey-light brown exterior and light brown interior. The vessel body is decorated with a finger-impressed curved rib and applied barbotine.
L. 14.5 cm, W. 9.8 cm, Th. 1.4 cm

6. Trench 23B, Context 481, Find no. 14088
Base fragment of a large, chaff-tempered storage jar with dark grey exterior and light brown interior. The base is thickened. Joined from four pieces.
H. 6.7 cm, W. 15.2 cm, dB. 27 cm, ThB. 3.9 cm

7. Trench 23B, Context 423, Find no. 11128
Base fragment of a large, chaff-tempered storage jar with light grey-dark grey exterior and light brown interior. The base is thickened.
H. 5.2 cm, W. 18.2 cm, dB. 24 cm, ThB. 2.8 cm

Fig. 27.27. Restored pannier vessel and fragments of pannier vessels

1. Trench 23B, Context 344, Find no. 7312
Rim, neck and shoulder fragment of a chaff-tempered pannier vessel with light brown exterior and light brown, grey mottled interior. The everted rim is rounded. A horizontal handle is set on the shoulder. Joined from three fragments.
H. 9.4 cm, W. 10.9 cm, Th. 0.8 cm, dR. 12 cm, dH. 2.7 cm (inner)

2. Trench 23B, Context 300, Find no. 3000
Rim and neck fragment of a chaff-tempered vessel (probably a pannier) with light brown exterior and grey interior. The rim is rounded, the neck is outcurving. The interior is lightly polished.
H. 7.5 cm, W. 5.5 cm, Th. 0.7 cm, dR. 15 cm

3. Trench 23B, Context 313, Find no. 4339
Rim, shoulder and body fragment of a chaff-tempered pannier vessel with light brown, grey mottled exterior and interior. The rim is rounded, the short neck is funnel-shaped, the body is globular. A horizontal handle is set on the shoulder. The vessel body is lightly polished.
H. 11.7 cm, W. 11.4 cm, Th. 0.9 cm, dR. 14 cm, dH. 1.5 cm (inner)

4. Trench 23B, Context 430, Find no. 11385
Rim and neck fragment of a chaff-tempered vessel (probably a pannier) with light brown exterior and interior. The rim is rounded, the neck is funnel-shaped. Joined from two fragments.
H. 7.4 cm, W. 7.5 cm, Th. 0.6 cm, dR. 13 cm

5. Trench 23C, Context 530/531, Find no. 9649
Chaff-tempered pannier vessel with light brown exterior and interior. The rim is flat, the short neck is cylindrical, the body is globular, the base is thickened. A pair of horizontal handles was originally set on the shoulder and below the carination, but only one of each has survived. Assembled from its fragments.
H. 21.8 cm, Th. 0.8 cm, dR. 10.2 cm, dB. 9.5 cm, dH. 2.6 cm (inner)

Fig. 27.28. Altars

1. Trench 23B, Context 408, Find no. 10723
Rim of a chaff-tempered bowl with light brown exterior and light brown-dark grey interior, the upper part of an altar set on small feet. The rim is rounded. The vessel body is polished on both the exterior and interior.
H. 5.1 cm, W. 6 cm, Th. 0.7 cm, dR. of bowl 9 cm

2. Trench 23C, Context 508, Find no. 9175
Fragment of a chaff-tempered bowl with light brown-light grey exterior and interior, the upper part of an altar set on feet. The rim is rounded.
H. 2.6 cm, W. 6 cm, Th. 0.7 cm, dR. of bowl 11 cm

3. Trench 23C, Context 524, Find no. 9428
Chaff- and sand-tempered altar with light brown-light grey exterior and interior set on three feet. The upper part is a semi-spherical bowl with rounded rim. The single surviving, strap-like foot with trapezoidal section is a direct continuation of the bowl. Assembled from its fragments.
H. 7.7 cm, dF. 2.1 cm, Th. of bowl 0.5 cm, dR. of bowl 10 cm

4. Trench 23C, Context 537, Find no. 9646
Fragment of a chaff-tempered, dark grey and brown mottled, strap-like altar foot, probably from an altar set on three feet. It is decorated with a grooved rib. The surface is polished.
H. 6.4 cm, W. 5 cm, Th. 1.3 cm, dF. 3.3 cm

5. Trench 23B, Context 423, Find no. 11151
Chaff-tempered, light brown-light grey-dark grey altar set on four feet. The upper part is a semi-spherical bowl with rounded rim. The oval sectioned feet are a direct continuation of the bowl. Assembled from its fragments.
H. 6.3 cm, Th. of bowl 0.5 cm, dR. of bowl 5.3 cm, dF. 1.6 cm

Fig. 27.29. Altars

1. Trench 23B, Context 422, Find no. 11051
Fragment of a chaff-tempered, light brown, curved altar foot with trapezoidal section. The foot is decorated with two incised lines on one side, and single lines on the others.
H. 4 cm, Th. 1.4 cm, diam. 1.2 cm

2. Trench 23B, Context 354, Find no. 7689
Fragment of a chaff-tempered altar foot with drop-shaped section.
H. 4.4 cm, diam. 1.9 cm

3. Trench 23B, Context 470, Find no. 13779
Fragment of a chaff-tempered, grey altar foot with drop-shaped section.
H. 4.5 cm, diam. 1.9 cm

4. Trench 23B, Context 475, Find no. 14265
Corner fragment of a chaff-tempered, grey, rectangular altar. The stub of the foot suggests that it had a drop shaped section.
H. 3.5 cm, L. 5.9 cm, W. 5.2 cm, dF. 2 cm

Fig. 27.30. Flowerpot-shaped vessel and bowls

1. Cf. Fig. 27.9. 3
2. Cf. Fig. 27.13. 1
3. Cf. Fig. 27.13. 2
4. Cf. Fig. 27.14. 1
5. Cf. Fig. 27.14. 2
6. Cf. Fig. 27.14. 3

Fig. 27.31. Bowl with an S profile, cups, mug and globular vessels

1. Cf. Fig. 27.19. 1
2. Cf. Fig. 27.20. 1
3. Cf. Fig. 27.20. 2
4. Cf. Fig. 27.21. 1
5. Cf. Fig. 27.21. 2
6. Cf. Fig. 27.23. 4

Fig. 27.32. Storage jars, pannier vessel and altars

1. Cf. Fig. 27.25. 2
2. Cf. Fig. 27.25. 3
3. Cf. Fig. 27.27. 5
4. Cf. Fig. 27.28. 3
5. Cf. Fig. 27.28. 5

Fig. 27.33–34. Vessel forms

Fig. 27.35–40. Diagrams

Fig. 27.41. Pottery decorated with finger and nail impressions

1. Trench 23A, Context 134, Find no. 1486
Body fragment of a chaff-tempered, light brown vessel. The interior surface has been entirely lost. The vessel body is covered with nail impressions. This fragment was perhaps part of the same vessel as the one described under no. 3.
L. 7.2 cm, W. 6.1 cm

2. Trench 23A, Context 104, Find no. 1043
Body fragment of a chaff-tempered vessel with light brown-grey exterior and light brown interior. It is covered with nail impressions.
L. 6.5 cm, W. 5.1 cm, Th. 0.8 cm

3. Trench 23A, Context 136, Find no. 1611
Body fragment of a chaff-tempered, light brown vessel. The interior surface has been entirely lost. It is de-corated with nail impressions. This fragment was perhaps part of the same vessel as the one described under no. 1.
L. 10.2 cm, W. 6.7 cm

4. Trench 23B, Context 422, Find no. 11008
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is covered with nail impressions.
L. 6.8 cm, W. 5.3 cm, Th. 0.6 cm

5. Trench 23B, Context 445, Find no. 13118
Rim and body fragment of a chaff-tempered vessel with light brown exterior and interior. The rim is decorated with finger impressions, the vessel body with finger impressions arranged in two vertical rows.
L. 8.6 cm, W. 6.7 cm, Th. 1.6 cm

6. Trench 23B, Context 430, Find no. 11280
Rim and body fragment of a chaff-tempered vessel with light brown exterior and interior. The rim is decorated with finger impressions, as is the vessel body.
L. 8.5 cm, W. 4.1 cm, Th. 1.9 cm

7. Trench 23B, Context 340, Find no. 6389
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with dense nail and finger impressions and a knob.
L. 16 cm, W. 9.5 cm, Th. 1.7 cm

Fig. 27.42. Pottery with pinched decoration

1. Trench 23B, Context 445, Find no. 12874
Rim and body fragment of a chaff-tempered vessel with light brown exterior and dark grey-brown interior. The rim is decorated with finger impressions, the vessel body with a pinched pattern.
H. 6.3 cm, W. 10 cm, Th. 1 cm, dR. 28 cm

2. Trench 23B, Context 461, Find no. 12961
Rim, neck and shoulder fragment of a chaff-tempered globular vessel with light brown exterior and grey-light brown interior. The rim is decorated with finger impressions. The short neck is cylindrical. The vessel body is covered with a pinched pattern.
H. 7 cm, W. 8.8 cm, Th. 1.3 cm, dR. 18 cm

3. Trench 23B, Context 301, Find no. 3508
Rim and body fragment of a chaff-tempered globular vessel with light brown, grey mottled exterior and light brown interior. The rim is decorated with finger impressions, the vessel body with a pinched pattern.
H. 10.7 cm, W. 10.3 cm, Th. 1 cm, dR. 16 cm

4. Trench 23A, Context 126, Find no. 1285
Rim and shoulder fragment of a chaff-tempered vessel with light brown exterior and dark grey-light brown interior. The rim is decorated with finger impressions, the vessel body with a pinched pattern.
H. 7.8 cm, W. 9.8 cm, Th. 1.2 cm, dR. 26 cm

5. Trench 23B, Context 430, Find no. 11582
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The interior has been almost completely lost. The vessel body is covered with a pinched pattern.
L. 12.4 cm, W. 7.4 cm, Th. 2.2 cm

6. Trench 23B, Context 445, Find no. 13089
Body fragment of a chaff-tempered vessel with light brown exterior and dark grey interior. The vessel body is decorated with a pinched pattern.
L. 7.3 cm, W. 5.5 cm, Th. 0.8 cm

7. Trench 23B, Context 445, Find no. 13118
Body fragment of a chaff-tempered vessel with light brown-grey exterior and light brown interior. The vessel body is decorated with a pinched pattern.
L. 9.5 cm, W. 8.5 cm, Th. 1 cm

8. Trench 23A, Context 104, Find no. 1043
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a pinched pattern.
L. 7.6 cm, W. 6.5 cm, Th. 1.4 cm

Fig. 27.43. Pottery with spike motif decoration

1. Trench 23B, Context 422, Find no. 11039
Rim and body fragment of a chaff-tempered vessel with light brown exterior and interior. The rim is decorated with finger impressions, the vessel body with spike motifs.
H. 6.4 cm, W. 9 cm, Th. 1.4 cm

2. Trench 23B, Context 445, Find no. 12810
Rim, neck and body fragment of a chaff-tempered vessel with light brown exterior and interior. The short neck is cylindrical. The rim is decorated with nail impressions, the vessel body with spike motifs.
H. 5.1 cm, W. 4.5 cm, Th. 0.6 cm, dR. 8 cm

3. Trench 23B, Context 430, Find no. 11296
Rim, neck and body fragment of a chaff-tempered vessel with light brown exterior and dark grey interior. The neck is everted. The rim is decorated with finger impressions, the vessel body with spike motifs. Joined from five fragments.
H. 8.2 cm, W. 8.6 cm, Th. 0.5 cm

4. Trench 23B, Context 430, Find no. 11301
Body fragment of a chaff-tempered vessel with light brown exterior and grey interior. The lightly polished vessel body is decorated with spike motifs.
L. 8.2 cm, W. 6.2 cm, Th. 0.9 cm

5. Trench 23C, Context 535, Find no. 9638
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with spike motifs.
L. 4.5 cm, W. 4.5 cm, Th. 1.2 cm

6. Trench 23B, Context 464, Find no. 14356
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. The surface is covered with spike motifs arranged in rows. Joined from two fragments.
L. 16 cm, W. 9.3 cm, Th. 0.7 cm

Fig. 27.44. Pottery with spike motifs arranged into rows and mussel impressions

1. Trench 23B, Context 464, Find no. 14188
Rim, neck and body fragment of a chaff-tempered vessel with light brown, grey mottled exterior and light brown-dark grey interior. The rim is decorated with finger impression, the vessel body with spike motifs arranged into rows.
H. 7.5 cm, W. 8 cm, Th. 0.9 cm

2. Trench 23B, Context 469, Find no. 14436
Rim, neck and body fragment of a chaff-tempered vessel with light brown exterior and dark grey interior. The rim is decorated with finger impressions, the vessel body with spike motifs arranged into rows. Joined from two fragments.
H. 7.5 cm, W. 6.9 cm, Th. 0.7 cm

3. Trench 23B, Context 301, Find no. 3618
Body fragment of a chaff-tempered vessel with light brown, grey mottled exterior and dark grey interior. The vessel body is decorated with spike motifs arranged into rows.
L. 5.2 cm, W. 3.7 cm, Th. 0.5 cm

4. Trench 23B, Context 445, Find no. 13089
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. The vessel body is decorated with spike motifs arranged into rows.
L. 7 cm, W. 5.5 cm, Th. 1.2 cm

5. Trench 23B, Context 431, Find no. 11484
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with spike motifs arranged into rows.
L. 8.4 cm, W. 7.2 cm, Th. 1.3 cm

6. Trench 23B, Context 357, Find no. 7434
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with spike motifs arranged into rows.
L. 8.1 cm, W. 6.7 cm, Th. 1 cm

7. Trench 23B, Context 300, Find no. 3281
Body fragment of a chaff-tempered vessel with light brown exterior and brown, grey mottled interior. The vessel body is decorated with spike motifs arranged into rows.
L. 8.2 cm, W. 6.6 cm, Th. 1 cm

8. Trench 23A, Context 109, Find no. 1190
Body fragment of a chaff-tempered vessel with light brown exterior and light brown-dark grey interior. The vessel body is decorated with mussel impressions (although it is possible that the decoration is in fact made up of stronger and longer nail impressions).
L. 5.4 cm, W. 3.4 cm, Th. 1.2 cm

Fig. 27.45. Pottery with grooved decoration

1. Trench 23C, Context 508, Find no. 9165
Rim and body fragment of a chaff-tempered vessel with light brown exterior and light brown-light grey interior. The vessel body is decorated with grooving.
H. 6.5 cm, W. 7.2 cm, Th. 1 cm

2. Trench 23C, Context 538, Find no. 9653
Rim fragment of a chaff-tempered vessel with light brown exterior and interior. The rim is decorated with finger impressions, the vessel body with grooving.
L. 3.3 cm, W. 2.5 cm, Th. 0.6 cm

3. Trench 23B, Context 445, Find no. 12768
Body fragment of a chaff-tempered vessel with brown exterior and grey, brown mottled interior. The vessel body is decorated with grooving.
L. 6.5 cm, W. 5.3 cm, Th. 1.4 cm

4. Trench 23B, Context 311, Find no. 4162
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with grooving.
L. 4.4 cm, W. 4.4 cm, Th. 1.4 cm

5. Trench 23C, Context 500, Find no. 9005
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with grooving.
L. 10.6 cm, W. 5.3 cm, Th. 1.1 cm

6. Trench 23C, Context 520, Find no. 9400
Body fragment of a chaff-tempered vessel with light brown exterior and greyish-brown interior. The vessel body is decorated with grooving.
L. 5.3 cm, W. 4.8 cm, Th. 1.3 cm

7. Trench 23A, Context 104, Find no. 1043
Body and base fragment of a chaff-tempered vessel with light brown exterior and light brown-grey interior. The base is thickened. The vessel body is decorated with grooving.
H. 6 cm, W. 11.3 cm, Th. 1 cm, dB. 12 cm

8. Trench 23B, Context 422, Find no. 11095
Rim, neck and shoulder fragment of a chaff-tempered vessel with light brown exterior and interior. The everted rim is decorated with finger impressions, the vessel body with grooving.
H. 5.8 cm, W. 6.1 cm, Th. 0.8 cm, dR. 18 cm

Fig. 27.46. Pottery decorated with lattice patterns

1. Trench 23B, Context 301, Find no. 3632
   Trench 23B, Context 301, Find no. 3697
Rim and body fragment of a chaff-tempered vessel with grey, brown mottled exterior and interior. The rim is decorated with impressions, the body with an incised lattice pattern. Joined from two fragments.
H. 5 cm, W. 6.7 cm, Th. 0.8 cm

2. Trench 23B, Context 371, Find no. 8712
Body fragment of a chaff-tempered vessel with brown exterior and light brown, grey mottled interior. The vessel body is lightly polished and covered with an incised lattice pattern.
L. 7.2 cm, W. 6.2 cm, Th. 1.1 cm

3. Trench 23B, Context 430, Find no. 11574
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a deeply incised lattice pattern.
L. 6.8 cm, W. 4.7 cm, Th. 1.1 cm

4. Trench 23B, Context 422, Find no. 11039
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a deeply incised lattice pattern.
L. 5.8 cm, W. 4 cm, Th. 1 cm

5. Trench 23B, Context 373, Find no. 8224
Body fragment of a chaff-tempered vessel with light brown exterior and brownish-grey interior. The vessel body is decorated with an incised lattice pattern.
L. 10.5 cm, W. 5.3 cm, Th. 1.1 cm

6. Trench 23C, Context 511, Find no. 9252
Body and base fragment of a chaff-tempered vessel with light brown exterior and interior. The base is thickened. The vessel body is decorated with an incised lattice pattern.
H. 5.5 cm, W. 8 cm, Th. 1.6 cm, ThB. 3.4 cm

7. Trench 23C, Context -, Find no. 9008
Body fragment of a chaff-tempered vessel with light brown, brownish-red mottled exterior and light brown interior. The vessel body is decorated with a lightly incised lattice pattern.
L. 6.5 cm, W. 6 cm, Th. 1.4 cm

8. Trench 23B, Context 430, Find no. 11876
Body and base fragment of a chaff-tempered vessel with light brown exterior and grey interior. The base is thickened. The vessel body is decorated with a lightly incised lattice pattern. Joined from three fragments.
H. 5.1 cm, W. 6.5 cm, Th. 0.7, dB. 9 cm, ThB. 1.1 cm

Fig. 27.47. Pottery decorated with incised lattice and linear patterns

1. Trench 23B, Context 301, Find no. 3677
Base fragment of a chaff-tempered vessel with grey exterior and interior. The thickened base is decorated with a lightly incised lattice pattern.
H. 3.8 cm, W. 9.7 cm, Th. 0.9 cm, dB. 14 cm, ThB. 1.7 cm

2. Trench 23B, Context 464, Find no. 14416
Rim, neck and body fragment of a chaff-tempered globular vessel with light brown exterior and grey interior. The everted rim is thickened and decorated with finger impressions. The shoulder and the body are covered with a pattern of incised lines. Joined from two fragments.
H. 9.4 cm, W. 7 cm, Th. 0.8 cm

3. Trench 23B, Context 430, Find no. 11616
Rim, neck and shoulder fragment of a chaff-tempered globular vessel with light brown exterior and interior. The everted rim is thickened and decorated with finger impressions. The stub of a horizontal handle survives on the shoulder. The vessel body bears a pattern of obliquely incised lines.
H. 7.3 cm, W. 5 cm, Th. 0.7 cm

4. Trench 23B, Context 430, Find no. 11403
Trench 23B, Context 445, Find no. 12833
Trench 23B, Context 422, Find no. 11095

Rim and body fragment of a large, chaff-tempered bowl with light brown exterior and reddish-brown interior. The rim is decorated with finger impressions. The vessel body above the carination is cylindrical, the lower part is conical. The vessel body is decorated with lightly incised oblique lines. Joined from four fragments.
H. 11.6 cm, W. 12.5 cm, Th. 1.2 cm

5. Trench 23B, Context 439, Find no. 11928
Body fragment of a large, chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with incised lines.
L. 11.5 cm, W. 7.7 cm, Th. 1.6 cm

6. Trench 23C, Context 507, Find no. 9117
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The body is decorated with incised lines.
L. 6.4 cm, W. 5 cm, Th. 1.1 cm

Fig. 27.48. Pottery with incised linear patterns

1. Trench 23C, Context 528, Find no. 9482
Body fragment of a chaff-tempered vessel with light brown exterior and brownish-grey interior. The vessel body is decorated with incised lines.
L. 9.7 cm, W. 7.6 cm, Th. 1 cm

2. Trench 23B, Context 300, Find no. 3036
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. The vessel body is decorated with incised lines.
L. 8 cm, W. 7.2 cm, Th. 1.2 cm

3. Trench 23B, Context 464, Find no. 14128
Body and base fragment of a chaff-tempered vessel with light brown exterior and dark grey, light brown mottled interior. The base is thickened. The vessel body is decorated with incised lines.
H. 4.3 cm, W. 7.7 cm, Th. 1.6 cm

4. Trench 23B, Context 445, Find no. 12858
Body and base fragment of a chaff-tempered vessel with light brown exterior and interior. The base is thickened. The vessel body is decorated with incised lines.
H. 4.7 cm, W. 5.9 cm, Th. 1.6 cm, ThB. 2.7 cm

5. Trench 23A, Context 104, Find no. 1169
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. The vessel body is decorated with pairs of incised lines.
L. 11 cm, W. 8.7 cm, Th. 1.3 cm

6. Trench 23B, Context 344, Find no. 7310
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with pairs of incised lines.
L. 7.6 cm, W. 5.9 cm, Th. 1 cm

7. Trench 23B, Context 327, Find no. 5078
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with pairs of incised lines.
L. 7.5 cm, W. 6.2 cm, Th. 1.3 cm

8. Trench 23C, Context 509, Find no. 9236
Rim and body fragment of a chaff-tempered vessel with light brown exterior and interior. The rim is decorated with finger impressions, the vessel body with an incised herringbone-like pattern.
H. 7.3 cm, W. 5.1 cm, Th. 0.6 cm

Fig. 27.49. Pottery decorated with stroke burnished patterns

1. Trench 23B, Context 464, Find no. 14338
Body fragment of a chaff- and sand-tempered vessel with grey exterior and interior. The polished vessel body is decorated with a stroke-burnished zig-zag pattern.
L. 7.5 cm, W. 6.7 cm, Th. 0.9 cm

2. Cf. Fig. 27.24. 2.

Fig. 27.50. Pottery decorated with ribs

1. Trench 23B, Context 457, Find no. 13212
Body fragment of a chaff-tempered vessel with light brown, grey mottled exterior and interior. A rib with nail impressions is set on the body.
L. 8.8 cm, W. 6.4 cm, Th. 1.8 cm

2. Trench 23B, Context 464, Find no. 14168
Body fragment of a chaff-tempered vessel with light brown exterior and light brown, grey mottled interior. A wide, finger-impressed rib decorates the body. Joined from three fragments.
L. 14.5 cm, W. 12.3 cm, Th. 0.9 cm

3. Trench 23B, Context 445, Find no. 12825
Body fragment of a chaff-tempered vessel with light brown-grey exterior and grey, light brown mottled interior. A curved rib with impressions decorates the body.
L. 13.5 cm, W. 8.4 cm, Th. 1 cm

4. Trench 23B, Context 430, Find no. 11612
Body fragment of a chaff-tempered vessel with dark grey, light brown mottled exterior and light brown interior. A rib decorated with impressions is set on the body.
L. 9 cm, W. 7.4 cm, Th. 1.2 cm

5. Trench 23B, Context 445, Find no. 13196
Body fragment of a chaff- and sand-tempered vessel with light brown exterior and interior. A double rib with smoothed edges is set on the body.
L. 4.2 cm, W. 3.4 cm, Th. 0.3 cm

6. Trench 23A, Context 102, Find no. 1011
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The body is decorated with a pinched pattern and a curved rib.
L. 10 cm, W. 8.3 cm, Th. 1 cm

7. Trench 23C, Context 509, Find no. 9236
Body fragment of a chaff- and sand-tempered vessel with light brown exterior and interior. The vessel body is decorated with ribs with smoothed edges.
L. 4.3 cm, W. 4 cm, Th. 0.8 cm

8. Trench 23C, Context 535, Find no. 9638
Body fragment of a chaff- and sand-tempered vessel with grey exterior and interior. The vessel body is decorated with curved ribs with smoothed edges.
L. 11 cm, W. 6.7 cm, Th. 0.8 cm

Fig. 27.51. Pottery decorated with ribs and knobs

1. Trench 23B, Context 445, Find no. 13089
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a pair of curved ribs, perhaps originally part of an appliqué goat figure.
L. 9 cm, W. 6.5 cm, Th. 1 cm

2. Trench 23B, Context 464, Find no. 14209
Rim and body fragment of a chaff-tempered vessel with light brown, grey mottled exterior and light brown interior. The rim is rounded, the neck is outcurving. The vessel body is decorated with a V-shaped, notched rib, perhaps originally depicting the antlers of an appliqué deer figure.
H. 5.8 cm, W. 4.9 cm, Th. 1.3 cm

3. Trench 23B, Context 376, Find no. 10043
Body fragment of a chaff-tempered vessel with light brown exterior and grey, brown mottled interior. The vessel body is decorated with an impressed knob.
L. 14 cm, W. 8.3 cm, Th. 10 cm

4. Trench 23B, Context 445, Find no. 12833
Body fragment of a chaff-tempered vessel with light brown exterior and grey interior. The vessel body is decorated with an impressed knob.
L. 6.1 cm, W. 4.5 cm, Th. 1.2 cm

5. Trench 23B, Context 445, Find no. 11603
Body sherd of a chaff-tempered vessel with reddish-brown-light grey exterior and reddish-brown interior. A flat, disc-shaped, impressed knob is set on the vessel body. Joined from two fragments.
L. 10 cm, W. 8.4 cm, Th. 1 cm

6. Trench 23B, Context 469, Find no. 14391
Body sherd of a chaff-tempered vessel with light brown exterior and light grey, brown mottled interior. The vessel body is decorated with a flat, disc-shaped, impressed knob.
L. 9.7 cm, W. 7.3 cm, Th. 1 cm

7. Trench 23C, Context 537, Find no. 9646
Body fragment of a chaff-tempered vessel with light brown exterior and dark grey, brown mottled interior. A slightly pointed knob is set on the carination.
L. 8.5 cm, W. 7.3 cm, Th. 0.9 cm

8. Trench 23B, Context 445, Find no. 12845
Body fragment of a chaff-tempered vessel with brown exterior and grey-brown interior. The vessel body is decorated with a double knob.
L. 7 cm, W. 6.6 cm, Th. 1.2 cm

Fig. 27.52. Pottery decorated with knobs

1. Trench 23B, Context 301, Find no. 3610
Body sherd of a chaff-tempered vessel with light brown, grey mottled exterior and light brown interior. The vessel body is decorated with a double knob and a spike pattern.
L. 9.2 cm, W. 5 cm, Th. 0.6 cm

2. Trench 23B, Context 464, Find no. 14223
Body sherd of a chaff-tempered vessel with light brown, grey mottled exterior and grey-light brown interior. A double knob is set on the vessel body.
H. 10.2 cm, W. 9.3 cm, Th. 0.9 cm

3. Trench 23B, Context 301, Find no. 3084
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a knob divided in two by a finger impression.
L. 7.2 cm, W. 6.2 cm, Th. 1 cm

4. Trench 23B, Context 430, Find no. 11912
Body sherd of a chaff-tempered vessel with light brown exterior and grey interior. The vessel body is decorated with incised lines and a knob divided in two by a finger impression.
L. 9.5 cm, W. 9 cm, Th. 1 cm

5. Trench 23B, Context 431/440, Find no. 13589
Body sherd of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with a row of impressed knobs.
L. 6.5 cm, W. 4.5 cm, Th. 0.5 cm

6. Trench 23B, Context 431/440, Find no. 13589
Body fragment of a chaff-tempered vessel with light brown exterior and grey interior. An oval knob decorated with finger impressions is set on the vessel body.
L. 5 cm, W. 3.5 cm, Th. 0.5 cm

7. Trench 23B, Context 431, Find no. 11778
Body fragment of a chaff-tempered vessel with light brown exterior and grey-light brown interior. An oval knob decorated with finger impressions is set on the vessel body. Joined from three fragments.
L. 9.4 cm, W. 8.2 cm, Th. 1 cm

8. Trench 23B, Context 356, Find no. 10293
Body fragment of a chaff-tempered vessel with light brown exterior and brownish-grey interior. An oval knob decorated with finger impressions is set on the vessel body.
L. 6.8 cm, W. 4.6 cm, Th. 0.7 cm

9. Trench 23B, Context surface, Find no. 13657
Body sherd of a chaff-tempered vessel with light brown exterior and interior. An oval knob decorated with impressions is set on the vessel body.
L. 8 cm, W. 5 cm, Th. 1 cm

Fig. 27.53. Applied barbotine

1. Trench 23B, Context 464, Find no. 14226
Body sherd of a chaff-tempered vessel with light brown exterior and light brown-grey interior. The vessel body is decorated with applied barbotine.
L. 9 cm, W. 5 cm, Th. 0.7 cm

2. Trench 23C, Context 501, Find no. 9007
Body fragment of a chaff-tempered vessel with light grey exterior and light brown interior. The vessel body is decorated with applied barbotine.
L. 9 cm, W. 7 cm, Th. 1.6 cm

3. Trench 23A, Context 139, Find no. 1566
Body fragment of a chaff-tempered vessel with light brown exterior. The interior has been entirely lost. The vessel body is decorated with applied barbotine.
L. 14 cm, W. 12.6 cm

4. Trench 23B, Context 300, Find no. 3037
Body fragment of a chaff-tempered vessel with light brown exterior and grey, light brown mottled interior. The vessel body is decorated with applied barbotine.
L. 6.7 cm, W. 5.3 cm, Th. 0.7 cm

5. Trench 23B, Context 423, Find no. 11136
Body fragment of a chaff-tempered vessel with greyish-brown exterior and interior. The vessel body is decorated with applied barbotine.
L. 8 cm, W. 5.7 cm, Th. 0.9 cm

6. Trench 23B, Context 445, Find no. 13137
Neck and body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with applied barbotine divided in two by finger impressions.
L. 10.4 cm, W. 10 cm, Th. 0.8 cm

Fig. 27.54. Pottery decorated with Schlickwurf barbotine

1. Trench 23B, Context 301, Find no. 3021
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 7 cm, W. 5 cm, Th. 0.8 cm

2. Trench 23B, Context 314, Find no. 4477
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 8 cm, W. 7 cm, Th. 1 cm

3. Trench 23B, Context 445, Find no. 12810
Body fragment of a chaff-tempered vessel with light brown-light grey exterior and light brown interior. The vessel body is decorated with an incised lattice pattern and *Schlickwurf* barbotine, which in part extends over the incised pattern.
L. 7.5 cm, W. 4.7 cm, Th. 1.2 cm

4. Trench 23B, Context 464, Find no. 14121
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 9.5 cm, W. 8 cm, Th. 1.2 cm

5. Trench 23B, Context 301, Find no. 3021
Body fragment of a chaff-tempered vessel with light brown exterior and dark grey interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 5.1 cm, W. 4.9 cm, Th. 1.3 cm

6. Trench 23C, Context 520, Find no. 9509
Body fragment of a chaff-tempered vessel with light brown exterior and light brown-grey interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 4.7 cm, W. 4.5 cm, Th. 1.2 cm

7. Trench 23B, Context 464, Find no. 14157
Body fragment of a chaff-tempered vessel with light brown exterior and interior. The vessel body is decorated with *Schlickwurf* barbotine.
L. 6.2 cm, W. 4.4 cm, Th. 0.8 cm

Fig. 27.55. Polished pottery

1. Trench 23B, Context 430, Find no. 11822
Rim and body fragment of a chaff- and sand-tempered vessel with black exterior on the upper part, light brown exterior on the lower part and dark grey-light brown interior. The rim is rounded. The vessel body is polished. Joined from two fragments.
H. 9.7 cm, W. 7.7 cm, Th. 0.7 cm

2. Trench 23B, Context 320/330/336, Find no. 5143
Trench 23B, Context 341, Find no. 5786
Rim and body fragment of a chaff- and sand-tempered globular vessel with dark grey exterior and interior. The rim is rounded, the short neck is cylindrical. The vessel body is polished both on the exterior and interior. Joined from two fragments.
H. 4.4 cm, W. 9 cm, Th. 0.4 cm, dR. 12 cm

3. Trench 23B, Context 424, Find no. 12483
Rim and neck fragment of a chaff- and sand-tempered vessel with grey exterior and interior. The rim is rounded. The vessel body is polished both on the exterior and interior.
L. 3.7 cm, W. 2.5 cm, Th. 0.4 cm

4. Trench 23B, Context 396, Find no. 10351
Body fragment of a chaff- and sand-tempered vessel with black exterior and dark grey interior. The vessel body is polished on both the exterior and interior.
L. 3.7 cm, W. 2.8 cm, Th. 0.7 cm

5. Trench 23B, Context 330, Find no. 4827
Neck and body fragment of a chaff- and sand-tempered vessel with black exterior and dark grey interior. The vessel body is polished on both the exterior and interior.
L. 3.6 cm, W. 3.4 cm, Th. 0.5 cm

6. Trench 23B, Context 419, Find no. 10736
Rim and neck fragment of a sand-tempered vessel with dark grey exterior and interior and greyish-brown rim. The rim is thinned. The vessel body was polished on both the exterior and interior.
H. 3.4 cm, W. 5.3 cm, Th. 0.4 cm, dR. 10 cm

Fig. 27.56. Slip-covered pottery

1. Trench 23B, Context 497, Find no. 14740
Trench 23B, Context 601, Find no. 14781
Body fragment of a chaff- and sand-tempered vessel with light brown exterior and interior under the slip. The vessel body is covered with a reddish-brown slip on the exterior and interior (it has mostly worn off on the interior). The slip-covered vessel body is polished. Joined from two fragments.
L. 5 cm, W. 4.1 cm, Th. 0.8 cm

2. Trench 23B, Context 356, Find no. 10550
Body fragment of a sand-tempered vessel with light brown exterior and interior under the slip. The vessel is covered with a slip; it is reddish on the strongly worn exterior and reddish-brown on the less worn interior. Traces of polishing can be noted on the interior.
L. 2.2 cm, W. 1.8 cm, Th. 0.5 cm

3. Trench 23B, Context 313, Find no. 4252
Body fragment of a sand-tempered vessel with light brown exterior and dark grey interior under the slip. The vessel body is covered with a polished reddish-brown slip on both the exterior (where it is strongly worn) and interior (where it has survived to a greater extent).
L. 2.1 cm, W. 1.2 cm, Th. 0.3 cm

4. Trench 23B, Context 313, Find no. 4267
Body fragment of a sand-tempered vessel with light brown exterior and dark grey interior under the slip. The vessel body is covered with a polished reddish-brown slip on both the exterior (where it is strongly worn) and interior (where it has survived to a greater extent).
L. 2.1 cm, W. 2.1 cm, Th. 0.3 cm

5. Trench 23A, Context 105, Find no. 1047
Body sherd of a chaff- and sand-tempered vessel with light brown exterior and interior under the slip. The exterior is covered with a worn red slip, originally perhaps reddish-brown in colour. The slip-covered vessel body is polished.
L. 3.5 cm, W. 2.3 cm, Th. 0.3 cm

6. Trench 23B, Context 473, Find no. 13875
Body fragment of a sand-tempered vessel with light and dark grey exterior and light brown interior under the slip. The vessel had originally been covered with a reddish-brown slip, now much worn and coloured red on the exterior and interior of the vessel body. The slip-covered vessel body bears traces of polishing.
L. 2 cm, W. 1.7 cm, Th. 0.6 cm

Fig. 27.57. Diagram

Fig. 27.58. AVK pottery finds

1. Trench 23A, Context 103, Find no. 1112
Neck and shoulder fragment of a vessel with grey and light brown exterior and interior tempered with crushed pottery and sand. The neck is cylindrical. An incised line encircles the base of the neck.
L. 4.3 cm, W. 3 cm, Th. 0.5 cm

2. Trench 23A, Context 102, Find no. 1022
Body fragment of a vessel with dark grey exterior and interior tempered with crushed pottery and sand. The vessel body is decorated with densely incised parallel lines stepped at right-angles.
L. 2.8 cm, W. 2.5 cm, Th. 0.5 cm

3. Trench 23A, Context 103, Find no. 1112
Neck and shoulder fragment of a vessel with grey and light brown exterior and dark grey interior tempered with crushed pottery and sand. A smoothed-in line encircles the base of the neck.
L. 4.5 cm, W. 2.8 cm, Th. 0.4 cm

4. Trench 23A, Context 103, Find no. 1035
Body fragment of a sand-tempered vessel with light brown-grey exterior and dark grey interior. The vessel body is decorated with a deeply incised wide line.
L. 4.5 cm, W. 3.4 cm, Th. 0.7 cm

5. Trench 23A, Context 103, Find no. 1035
Body fragment of a vessel with light brown-grey exterior and dark grey interior tempered with crushed pottery and sand. The vessel body is decorated with an incised pattern of parallel lines filled with short stabs. The interior is lightly polished.
L. 7 cm, W. 4.3 cm, Th. 0.7 cm

6. Trench 23A, Context 105, Find no. 1058
Body fragment of a sand-tempered vessel with light brown exterior and light brown-reddish interior. The vessel body is decorated with slightly curved incised lines. The fragment is perforated.
L. 4.9 cm, W. 4.4 cm, Th. 0.3 cm, diam. of perforation 0.2 cm

7. Trench 23A, Context 101/102, Find no. 1031
Body fragment of a sand-tempered vessel with light brown, grey mottled exterior and light brown interior. The exterior is decorated with an incised curved line, the interior with a straight one.
L. 4.9 cm, W. 2.9 cm, Th. 0.5 cm

Fig. 27.59. AVK pottery finds

1. Trench 23A, Context 102, Find no. 1009
Body fragment of a sand-tempered vessel with light brown exterior and light grey interior. The vessel body is decorated with an incised curved line.
L. 2.5 cm, W. 2.5 cm, Th. 0.4 cm

2. Trench 23A, Context 101/102, Find no. 1028
Rim and body fragment of a chaff- and sand-tempered vessel with light brown exterior and reddish-brown interior. The rim is rounded. The vessel body is decorated with incised straight and curved lines.
L. 5.2 cm, W. 4.8 cm, Th. 0.4 cm

3. Trench 23A, Context plough zone, Find no. 1453
Body fragment of a chaff- and sand-tempered vessel with light grey-light brown exterior and interior. The vessel body is decorated with incised straight and wavy lines.
L. 4.5 cm, W. 4.1 cm, Th. 0.5 cm

4. Trench 23A, Context 105, Find no. 1057
Fragment of a chaff- and sand-tempered pedestalled vessel with light brown exterior and interior. The vessel body is decorated with an incised wavy line.
H. 3.3 cm, W. 2.7 cm, Th. 0.5 cm

5. Trench 23A, Context 103, Find no. 1035
Body fragment of sand-tempered vessel with light brown, grey mottled exterior and interior. The vessel body is decorated with incised wavy lines.
L. 5.2 cm, W. 4 cm, Th. 0.4 cm

6. Trench 23B, Context 301, Find no. 3511
Spout fragment of a light grey, sand-tempered vessel. The rim is decorated with grooving and incised lines.
L. 2.7 cm, W. 2.5 cm, Th. 0.9 cm

7. Trench 23A, Context 102, Find no. 1019
Neck and shoulder fragment of a sand-tempered vessel with light brown-reddish-grey exterior and dark grey interior. The neck is cylindrical. A rectangular handle is set on the shoulder.
H. 7.3 cm, W. 5.9 cm, Th. 0.6 cm, ThH. 2.4 cm, dH. 1.5 cm (inner)

Fig. 27.60. AVK pottery finds

1. Trench 23A, Context 101/102, Find no. 1031
Rim and body fragment of a sand-tempered vessel with light brown exterior and light grey-dark grey interior. The rim is thinned.
H. 2.8 cm, W. 3.4 cm, Th. 0.2 cm

2. Trench 23A, Context 101/102, Find no. 1037
Rim fragment of a sand-tempered vessel with reddish exterior and light brown-reddish-light grey interior. The rim is flat and rounded along the edges.
H. 2 cm, W. 4.2 cm, Th. 0.5 cm

3. Trench 23A, Context 101/102, Find no. 1037
Rim and body fragment of a sand-tempered vessel with light grey exterior and light brown-light grey interior. The rounded rim is slightly thinned.
H. 4.4 cm, W. 5.7 cm, Th. 0.5 cm

4. Trench 23A, Context 101/102, Find no. 1031
Rim and body fragment of a sand-tempered vessel with light brown exterior and interior. The rim is flat.
H. 4 cm, W. 2.5 cm, Th. 0.3 cm

5. Trench 23A, Context 101/102, Find no. 1037
Rim and body fragment of a sand-tempered vessel with light brown exterior and interior. The rim is rounded.
H. 5.4 cm, W. 7.1 cm, Th. 0.3 cm

6. Trench 23A, Context 101/102, Find no. 1031
Rim and body fragment of a sand-tempered vessel with light brown exterior and interior. The rim is rounded. The vessel body is decorated with an incised line on the exterior and a pattern of incised zig-zagging lines ending in a pointed V on the interior. Joined from two fragments.
L. 5.5 cm, W. 4.2 cm, Th. 0.4 cm, dR. 13 cm

Fig. 27.61. AVK pottery finds

1. Trench 23A, Context 101, Find no. 1003
Base fragment of a chaff- and sand-tempered vessel with light brown exterior and dark grey-light brown interior. The base is flat. The vessel body is decorated with incised V-shaped motifs. Joined from two fragments.
H. 3.6 cm, W. 10.5 cm, dB. 10 cm, Th. 0.7 cm

2. Trench 23A, Context 101/102, Find no. 1031
Pedestal fragment of a sand-tempered pedestalled vessel: the hollow pedestal has a light brown exterior and interior, the interior of the upper part is light grey. The pedestal is decorated with an incised pattern of parallel lines. Joined from two fragments.
H. 5 cm, W. 5.4 cm, ThP. 0.6 cm

Fig. 27.62. AVK pottery finds

1. Trench 23A, Context 101/102, Find no. 1031
Base fragment of a sand-tempered vessel with light brown-light grey exterior and dark grey interior. The flat base is slightly concave.
H. 3.6 cm, W. 5.7 cm, Th. 0.6 cm, dB. 7 cm

2. Trench 23A, Context 102, Find no. 1013
Base fragment of a sand-tempered vessel with light brown-grey exterior and grey interior. The flat base is slightly concave.
H. 2 cm, W. 4.6 cm, Th. 3 cm, dB. 7 cm

3. Trench 23A, Context 101/102, Find no. 1031
Base fragment of a sand-tempered vessel with grey, brown mottled exterior and interior. The base is flat.
H. 3 cm, W. 4 cm, Th. 0.4 cm, dB. 5 cm

4. Trench 23A, Context 101/102, Find no. 1031
Base fragment of a chaff- and sand-tempered vessel with grey-light brown exterior and interior. The base is flat. Joined from five fragments.
H. 3.7 cm, Th. 0.7 cm, dB. 4.9 cm

Abbreviations

L.:	length
W.:	width
H.:	height
Th.:	thickness
diam.:	diameter
dR.:	diameter of rim
dB.:	diameter of base
dF.:	diameter of foot
dH.:	diameter of handle
ThB.:	thickness of base
ThH.:	thickness of handle
ThR.:	thickness of rim
ThP.:	thickness of pedestal
HF.:	height of foot
WF.:	width of foot

Chapter 28

FIGURAL REPRESENTATIONS AND OTHER CLAY OBJECTS

Krisztián Oross and *Alasdair Whittle*

Figurines

Three figurine fragments were found in Trench B. Two of these were figurine head fragments, and the third came from the lower part of a figurine.

Figurine heads

The two smaller head fragments come from so-called rod-headed figurines. Both were broken at the face and probably continued in a longish, cylindrical upper body. One fragment *(Fig. 28.1. 1)* has a flat top and an oval cross-section. The eyes are marked with two horizontal incisions, the separately applied nose having broken off. The depiction of the mouth is not known owing to the fracture. The head of another small figurine *(Fig. 28.1. 2)* was found in the main occupation deposit 342 in the Centre-West Box. The heavily worn fragment has a rounded top. The front and back of the cylindrical fragment is flattened and it has an oval cross-section. The eyes are indicated with two horizontal incisions, similarly to the previous fragment. The appliqué nose set between the eyes had broken off as on the other head fragment. The figurine was broken under the stub of the nose and thus the depiction of the mouth did not survive on the fragment.

Similar rod-headed idols with rounded top are known from Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, 79, pl. XLIII. 7–9, 11, pl. XLIV. 9) and Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, 79, pl. XLIV. 1–2); a fragment from Szentes-Jaksorérpart (Kutzián 1944, pl. XVII. 2) and two broken pieces from Nagykörű-Tsz gyümölcsös (Raczky 1978, figs 1–2) can likewise be assigned here. Other pieces come from Dudeştii Vechi/Óbesenyő (Kutzián 1944, 80, pl. XLIV. 4a–b) and Endrőd 119-Öregszőlők (Makkay 1992, pl. 29. 2, 5). A head fragment from Hódmezővásárhely-Kopáncs-Kovács-tanya (Kutzián 1944, 79, pl. XLIII. 10) bears a striking resemblance to the figurine fragment with rounded top from Ecsegfalva *(Fig. 28.1. 2)*.

Analogies to the flat-topped figurine head from Ecsegfalva can be quoted from Szajol-Felsőföld (Raczky 1980, fig. 2, fig. 4. 1–2, figs 5–6) and Endrőd 119-Öregszőlők (Makkay 1992, pl. 29. 1, 3).

Figurine fragment

A substantial fragment of a large legged and footed figurine *(Fig. 28.1. 3)* was found in the uppermost deposit 422 of the North Extension. The fabric is fine, fired to light brown and grey colours, but the surface is not particularly smoothed. The fragment depicts one of the legs and the lowermost part of the steatopygous buttocks. The slightly roughened surface on the left side clearly shows that the figurine's lower half was fitted together from two symmetrical parts and that the left half of the buttocks and the left leg was attached at this point. The surviving right foot has an oval base. The knee is indicated with a pointed knob. This might have been the lower part of a figurine standing about 15 cm or higher.

Many steatopygous figurine fragments have been found on Körös sites. Fragments depicting the legs and the prominent buttocks came to light at Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, 78, pl. XLIII. 1, 5), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, 78, pl. XLIII. 2, 6), Szolnok (Kutzián 1944, 78, pl. XIII. 7) and Tiszaug-Tópart (Kutzián 1944, 78, pl. VIII. 1–2). Another fragment was found at Bački Monoštor/Monostorszeg-Opoljenik near Sombor/Zombor in Serbia (Kutzián 1944, 24, pl. XIII. 5, 8). Other steatopygous figurine fragments have been uncovered at Röszke-Lúdvár (Trogmayer 2003, pl. 5. 1–2). Comparable pieces are known from Kengyel-Csonka-tanya (Raczky 1980, fig. 7. 1a–c), Nagykörű-Tsz gyümölcsös (Raczky 1978, fig. 2. 2), Szajol-Felsőföld (Raczky 1980, fig. 3, fig. 4. 8), Szajol-Tinóka ér (Raczky 1980, fig. 7. 4a–b), Szolnok-Feketeváros (Raczky 1980, fig. 7. 3a–b) and Tiszaföldvár-Újtemető (Raczky 1980, fig. 7. 2a–c), sites in the Tisza valley around Szolnok, some 60–70 km west of Ecsegfalva. Similar pieces were also found in greater number at Endrőd 119-Öregszőlők, some 30 km to the south-west of Ecsegfalva (Makkay 1992, pl. 28. 1–2, 4–7, pl. 29. 9).

Figurines of the Körös culture

In her monograph on the Körös culture, Ida Kutzián described the rod-headed and the steatopygous figurine fragments as representing two diverse types (Kutzián 1944, 78–79). However, one of the fragments found at Nagykörű-Tsz gyümölcsös (Raczky 1978, fig. 1. 2a–d) suggested that the long cylindrical upper part perhaps continued in a steatopygous lower half, and that the two distinctive fragment types were probably part of one and the same figurine type. This assumption was eventually confirmed by a fragment from Szajol-Felsőföld (Raczky 1980, fig. 1. 1a–c), on which substantial portions of the cylindrical upper and the steatopygous lower part had both survived (Raczky 1980, 10). A fragment from Endrőd 82-Lyukas-halom enabled the reconstruction of the entire rod-headed, steatopygous figurine with cylindrical upper part (Jankovich *et al.* 1989, 156–57, pl. 1. 2).

The eyes of this figurine type, so popular in the Körös culture, are generally indicated with two horizontal incisions. The separately modelled nose is set between the incisions. In contrast to the pieces from Ecsegfalva, the face of most figurines has survived intact, showing that the mouth is marked with an impression. The coiffure is generally depicted with densely incised lines, as on the pieces from Dudeştii Vechi/Óbesenyő (Kutzián 1944, pl. XLIV. 4a–b), Endrőd 39-Szujókereszt (Jankovich *et al.* 1989, 143–47, pl. 1a–b), Endrőd 119-Öregszőlők (Makkay 1992, pl. 29. 2, 5), Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XLIV. 8a–b) and Nagykörű-Tsz gyümölcsös (Raczky 1978, fig. 1. 1a–d, 2a–d). Two knobs on the long, cylindrical upper part mark the breasts. The breasts and the arms are both rendered with knobs on the figurine fragments from Nagykörű (Raczky 1978, fig. 1. 1a–c, 2a–c). The knobs are sometimes perforated, perhaps a schematic indication of arms resting on the breasts (Raczky 1980, 5, fig. 1. 1a–c). Judging from the figurines brought to light at Szajol-Felsőföld, the sex of the figurine was often indicated with an incision in the middle of a prominent triangle on the figurine's abdomen (Raczky 1980, fig. 1. 1a–c), although an inverted U-shaped incision too occurs on some pieces (Raczky 1980, fig. 1. 2a–c). The modelling of the breasts and the incisions on the abdomen clearly indicate the female nature of these figurines. Similarly to the piece from Ecsegfalva *(Fig. 28.1. 3)*, the lower part of these figurines was usually fitted together from two halves. Both halves of the lower part of some figurines found at Endrőd 119-Öregszőlők have survived (Makkay 1992, pl. 28. 1, 6, pl. 29. 9). The juncture of the two halves can be clearly observed on a piece from Röszke-Lúdvár (Trogmayer 2003, fig. 5. 2). The place of the tenon for fitting together the two halves can be noted on a piece from Nagykörű

(Raczky 1978, 7, fig. 2. 2b). Similarly to the Ecsegfalva figurine, small knobs mark the knees on the fragments from Endrőd 119-Öregszőlők (Makkay 1992, pl. 28. 7) and Hódmezővásárhely-Hámszárító (Kutzián 1944, 78, pl. XLIII. 3; Kalicz 1980a, 79, fig. 1b). A specimen from Nagykörű-Tsz gyümölcsös (Raczky 1980, fig. 7. 5a–b) has tiny knobs indicating the ankles.

Figurines of a different type have also been found on Körös sites. The finds from Röszke-Lúdvár include a figurine, which has a wide body with a short neck instead of a flattened, cylindrical one. This figurine has separately modelled, prominent arms (Trogmayer 2003, fig. 5. 1).

In addition to steatopygous and rod-headed figurines, Kutzián distinguished another type, on which the shoulders and the trunk were clearly depicted under the cylindrical neck. She also assigned the fragments with emphatically modelled breasts to a separate type (Kutzián 1944, 80–81). Examples of the former can be quoted from Hódmezővásárhely-Kotacpart-Vata-tanya (Kutzián 1944, pl. XLIV. 8a–b) and Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, pl. XLIV. 9), while two other pieces from Hódmezővásárhely-Kopáncs-Zsoldos-tanya (Kutzián 1944, pl. XLII. 5–6) and a fragment from Sövényháza (Kutzián 1944, pl. I. 6) represent the latter.

The triangular flat head and the depiction of the face on the steatopygous figurines from Méhtelek-Nádas in north-eastern Hungary (Kalicz and Makkay 1976, 18, Taf. 7. 1–4) distinguish these pieces from the figurines in the southern part of the Great Hungarian Plain. Small, 3–8 cm long rectangular figurines and their fragments representing an entirely different type were also found at this site. The eyes and the nose are depicted in the same manner as on the culture's other figurines (Kalicz and Makkay 1976, 19, Taf. 8. 1–8). The unique traits of the finds from Méhtelek-Nádas and a handful of other nearby Early Neolithic sites, differing from the Körös settlements in the southerly areas of the Great Hungarian Plain, are generally attributed to cultural impacts from the Transylvanian Criş culture. It has been suggested that these impacts can perhaps be linked to the migration of Criş groups through the Szamos valley toward the obsidian deposits in the Tokaj area (Kalicz and Makkay 1976, 23).

The three figurine fragments from the Ecsegfalva 23 site represent a type widespread in the Körös culture. Owing to their fragmentation, we do not know how the arms and the breasts were modelled, and neither do we know whether the sexual characteristic was marked on the abdomen. The finds from Ecsegfalva do not include figurine fragments representing less common types.

Broader parallels are to be found right through the Early Neolithic cultures of south-east Europe (Nandris 1970; Tringham 1971). The ambiguous representation of sex played out on these figurines, which can be seen as both female figurines and phallic symbols (Kokkinidou and Nikolaidou 1997; Whittle 1998b), should definitely be noted.

Face pot

The rim and neck fragment of a face pot came to light at Ecsegfalva *(Fig. 28.1. 4)*. The horizontal incision marking the left eye, a portion of the right eye marked in a similar manner, and the pointed, conical nose are all that survive of the face depiction. The vessel neck is funnel-shaped. Seeing that only the uppermost part of the vessel has survived, it is unclear whether the face depiction was part of an anthropomorphic or zoomorphic vessel; the former seems more likely because the fragment's size suggests a vessel falling within the size range of anthropomorphic vessels.

The face depictions on anthropomorphic vessels of the Körös culture were made using the same technique; the eyes are marked with horizontal incisions, the nose with a conical knob set between the eyes. The mouth is not depicted. The vessel neck is cylindrical or funnel-shaped. Face depictions of this type can be quoted from Hódmezővásárhely-Gorzsa-Kovács-tanya (Gazdapusztai 1957, 6, pl. 1. 3, pl. 2. 1–2; Kalicz 1980a, 79, fig. 2), Öcsöd (Kutzián 1944, 20–21, pl. XII. 10a–b; Kalicz 1980a, 79, fig. 3) and Rákóczifalva (Kalicz 1980a, 79, fig. 4), and a depiction of this type occurs also on a bird-shaped vessel from Felgyő (Csalog 1959, 10–11, pl. VI. 1a, 1d; Kalicz 1980a, 79, fig. 5). Foot fragments from anthropomorphic vessels, whose upper part (perhaps bearing a face depiction) is missing, are known from Hódmezővásárhely-Kotacpart-Vata-tanya (Banner 1935, 118, Taf. 18. 19), Kistőke-Karácsonytelke (Fogas 2003, 50, pl. 3. 2a–c) and Rákócziújfalu-Cseber-ér (Raczky 1980, 18, pl. 10. 7). Some fragments decorated with a face depiction come from pots, which were not anthropomorphic vessels. The fragment of a small face pot was brought to light at Szajol-Csikópart (Raczky 1980, 18, pl. 10. 3). A fragment with a differing face depiction has been published from Nagykörű-Tsz gyümölcsös (Raczky 1980, 18, pl. 10. 1); the painted almond shaped eyes on this fragment differ considerably from the incised eyes on the other fragments, as does the more realistically modelled nose.

Clay weights

Large perforated clay weights

Many fragments of typical Körös culture perforated clay weights were found throughout the excavated areas of Ecsegfalva 23. There were a few fairly or nearly intact examples. The great majority came from Trench B, but there were also, given the small size of the main sondage in XY 14/15, impressive numbers from Trench C, while only three fragments were recovered from the scoops and deposits in Trench A.

These objects are essentially fist- or hand-sized, normally roughly either rounded or cylindrical in form, with a central perforation and varying treatment of the external surface. They have been recovered in quantities since the first excavations of Körös culture sites. János Banner published several large perforated clay weights of varying sizes from Bukova-puszta, Dudeştii Vechi/Óbesenyő, Hódmezővásárhely-Kopáncs-Kovács-tanya, Hódmezővásárhely-Kopáncs-Zsoldos-tanya, Hódmezővásárhely-Kotacpart-Vata-tanya, Krstur/Szerbkeresztúr, Szarvas and Szentes-Jaksorpart (Banner 1932, 38, Taf. X. 1–31(32), Taf. XIX. 14–16, Taf. XXXII. 4–8, Taf. XXXVI. 97–112, Taf. XLI. 24). Following his interpretation of the function of these objects (Banner 1932, 22; 1937, 34), these clay artefacts are generally referred to as net sinkers or net weights. Here a more neutral term is preferred, and an alternative function as some kind of roof or thatch weight or ornament can be proposed.

Contexts, quantities and condition

Altogether 189 finds were recovered from Trench B, 33 from Trench C, and three from Trench A. In many instances, the find represents a single fragment, but frequently there were two to six fragments found close together, and occasionally more fragments; these were recorded as one find. Individual fragments were rarely more than 6 cm long. Eight fairly or nearly intact pieces were recovered from Trench B, in most cases cracked or otherwise fissured into fragments but still remaining in the ground as coherent wholes. The majority of these (seven out of the eight, the exception being from context 376 in the North Box), as also the majority of fragments as a whole from Trench B, came from the upper occupation deposits and especially from the northern part of the trench, but other fragments were found throughout the area and throughout the stratigraphy *(Appendix Table 28.1)*. These objects were therefore a feature of the site from its initial occupation, and their fragmentation can presumably in this instance at least (contrast Chapman 2000) be attributed to on-site processes of decay, trampling, burning, and accumulation and dumping of deposit. The finds from Trench C were found through the upper and middle part of the deposit, as deep as contexts 527 and 528; no complete piece was found.

Fabric

Most fragments are light brown, red, reddish or grey. Some of the redder fragments have been re-fired, but this has not been systematically analysed. Fabric is mostly fairly coarse with indications in some instances of a plant temper, perhaps from grass or reeds. One piece had grog temper.

Different types of large clay weights

Complete examples are rarely more than c. 11 cm in their greatest dimension. There appear to be two recurrent types: a more or less ovoid or cylindrical form, and a rounded, squat tomato-like form. With the exception of one type, all these objects, described separately below, have a central perforation, whose opening is normally not greater than 2 cm in diameter. The ovoid and cylindrical form seems normally to have had a diameter between 6 and 9 cm, while the tomato-like form could reach a diameter of 7.5–12 cm, with a central perforation up to 6.5 cm long.

Ovoid and cylindrical clay weights with central perforation
The external surface of the ovoid and cylindrical form could be left plain and smooth. Both fingernail and finger-tip impressions were frequent, mostly seemingly spread randomly over the external surface *(Fig. 28.2. 1–2, 4, 6)*. Impressions arranged into rows occur as well *(Fig. 28.2. 5)*. In one case, two circling rows of impressions were combined with four external grooves *(Fig 28.2. 3)*. Clay weights decorated with impressions are known from several Körös sites, e.g. from Szentes-Kurcapart (Kutzián 1944, pl. XVII. 10), Szentes-Nagyjaksorpart (Kutzián 1944, pl. XLV. 12–16), Szentes-Tűzköves (Kutzián 1944, pl. II. 8–9) and Tiszaug-Tópart (Kutzián 1944, pl. VIII. 5).

In several cases, shallow external grooves were found on this form, dividing the object into four portions *(Fig. 28.3. 3)*. In one instance, the external surface had been given five slight facets around its circumference *(Fig. 28.3. 2)*. One piece has four incised, curved, oblique grooves *(Fig 28.3. 1)*. The original form of a cylindrical fragment with a deep groove cannot be established *(Fig. 28.4. 3)*. Clay weights decorated with grooving are known from other Körös sites, such as Endrőd (Kutzián 1944, pl. XIV. 9) and Hódmezővásárhely-Kopáncs-Kovács-tanya (Kutzián 1944, pl. XLV. 10).

Tomato-shaped clay weights with central perforation
In her monograph on the Körös culture, Kutzián (1944, 82) described this lobed type as tomato-shaped. The external surface of the tomato-like form could also be left smooth. The fragments from Ecsegfalva 23 have the external surface divided into four portions by external grooves *(Fig. 28.3. 4–6)*. Some of these were shallow, as on the cylindrical form, but frequently these were deep and pronounced. The tomato-shaped clay weights from other Körös sites are three-, four-, five- or six-lobed, with the lobes generally decorated with impressions (Kutzián 1944, pl. I. 8–9, 13–14, pl. II. 7, 12, pl. VII. 14–15, pl. XI. 3, pl. XII. 11, pl. XVI. 1, 4, pl. XVII. 14, pl. XIX. 4, pl. XLV. 1–5, 7–8, 11). The pieces from Ecsegfalva, however, appear to have been undecorated.

Disc-shaped clay weights with central perforation
The finds include two thick, disc-shaped clay weights whose form and size resemble those of the tomato-shaped pieces, but are not divided into four or more lobes. One of these fragments is decorated with finger impressions *(Fig. 28.4. 1)*, the other is plain *(Fig 28.4. 2)*.

Cylindrical clay weights without central perforation
Differing from the pieces described above is a clay weight found in the North Extension *(Fig. 28.4. 4)*. This drum-like, cylindrical piece with flat ends does not have a central perforation.

Instead, an external groove circles the circumference at each end, and another shallow groove runs down the length of the object from flat end to flat end. Bracketing this long groove are two pairs of holes, the openings for narrow perforations. This object is intact. Its surface is well finished, and is light brown, red and dark grey (refiring cannot be excluded). Grooves and perforations seem sharp-edged and fresh. This piece came from the centre of a concentration of finds in the North Extension (see chapter 9, and further discussion below). The fragments of two other cylindrical weights without a central perforation were also found. Both fragments come from one end of the weight and the external groove can be clearly made out on them *(Fig. 28.4. 5–6).* One fragment has a groove running parallel to the weight's longitudinal axis *(Fig. 28.4. 5),* and the other has impressions around the edge *(Fig. 28.4. 6).*

This is an altogether rare form, though not completely unprecedented in the Körös culture. Kutzián published similar pieces from Sövényháza (Kutzián 1944, 83, pl. I. 10) and Szentes-Nagyjaksorpart (Kutzián 1944, 83, pl. XLV. 9). Other, rather similar intact and broken pieces come from the collection of the Vajda Péter School in Szarvas (Szarvas XLII in Jankovich *et al.* 1989, 480–82). The intact specimen was originally found with a fossilised string or cord attached, enabling the reconstruction of how it was suspended. János Makkay labelled the clay weights of this form 'Szarvas type' on the basis of this piece (Jankovich *et al.* 1989, 481, pl. 3. 6–7; Makkay 2001, 8 and front cover illustration). Other similar objects were recovered from the complex of Körös culture sites around Gyomaendrőd, including Endrőd 39-Szujókereszt (Jankovich *et al.* 1989, 143–147, pl. 3. 1–2). Some of the pieces representing this type have a prominent bulge on one side, such as the specimen from Endrőd 82-Lyukas-halom. Another similar piece, decorated with an incised lattice pattern, can be found in the Pokorny Collection in Gyoma (Gyoma XXII; Kutzián 1944, pl. XI. 2; Jankovich *et al.* 1989, 156–157, 280, pl. 3. 4–5). Kutzián believed that the weight from Gyoma (now in the collection of the Hungarian National Museum) was a unique anthropomorphic piece (Kutzián 1944, 20, pl. XI. 2).

Function

Complete objects of this kind may have a dry weight of around half a kilo. The combination of recurrent central perforation and meaningful mass seems to permit their interpretation as weights. There is no reason why they could not have functioned, as conventionally supposed, as weights for nets or lines, in an environment which lacked natural stone (Starnini and Szakmány 1998). From a contextual point of view, however, using the admittedly very circumscribed areas opened in Ecsegfalva 23, there is no compelling association between fishbone and these objects. The quantities of the former were considerable in the S-W Box in Trench B, but those of the latter modest; the situation is reversed in the North Extension. There need not of course have been any strong depositional link between net-related equipment and net-caught food residues, but the contextual associations at the very least allow other possibilities to be considered. The greatest concentration of these objects, including the intact piece without central perforation *(Fig. 28.4. 4),* comes from the North Extension, and coincides with pottery, bone tools, stone querns, animal bone, lithics, and smaller clay weights, as well as with areas of burnt daub including context 458 (see chapter 9). The association seems to be with a range of domestic activity, and with the presence of structures. These objects could therefore be proposed as some kind of roof or thatch weight or ornament.

Strung together, these individually quite light objects could have provided reasonable weight to help hold down roof or thatch, and the variety of forms and decoration speaks for something that was made to be seen. The diversity of detail is potentially very significant, though it may take a much bigger area-excavation of a Körös culture site for this fully to be realised. Bearing in mind both the dictum of Dobres (2000, 132) that people do not possess technology but enact it through knowledgeable practices, and the dictum of Evans (2003, chapter 3) that textures help people think, here is a small but significant part of the *habitus* of the Körös culture, textured to enhance familiarity on the one hand and some individuality on the other.

Clay weights without a central perforation *(Fig. 28.4. 4–6)* could be an unusual version of the more regularly found other types, or might have had another function (see below). The similar object from Szarvas has been interpreted as a net weight (Makkay 2001, 8).

Another, more recent suggestion is that these clay objects could have been used to provide heat for cooking, by the indirect moist heating method (Thissen 2005). The contextual details noted above would be consistent with this interpretation, and heating and reheating would explain the frequent fragmentation of these objects. Whether this explanation really deals with the perforations and grooves, which imply cords, which would not be heat- or fire-resistant, is another matter, and further technical study is required. This interpretation cannot be conclusively verified in the light of the currently available evidence.

Small perforated clay weights

The large majority of the 28 small perforated clay weights were intact. They were found exclusively in the upper occupation deposit in the North and West Extensions of Trench B *(Fig. 28.5. 1–9)*. These fit comfortably into the palm of a hand, and have a top perforation. Similar objects have been found on other Körös culture sites (Makkay 2001, 33–36, fig. 19–20), e.g. at Tiszaug-Tópart (Kutzián 1944, pl. VII. 16–17) and Endrőd 119-Öregszőlők (Makkay 1997, pl. II. 5–12). Small perforated clay weights were recovered from the Körös house uncovered at Tiszajenő-Szárazérpart (Raczky 1976, fig. 3. 13–15; Horváth and Paluch 2005, 257, fig. 41–43). Conventionally these are referred to as loom weights (from at least Banner 1937), and there is perhaps little need to challenge this kind of interpretation. Their context, as just noted above in the discussion of the larger perforated clay weights, is also significant.

Context

Apart from a few examples recovered in 2001 during the very first clean of the deposit in the North and West Extensions, all these objects were confined to a quite small area centred in squares L13–15, M10–15 and A11–14, coinciding again with the concentrations of other material described above and in chapter 9.

Fabric and form

Colours are varied, from dark, brown and grey-brown to light brown and red. Redder examples might be refired; one example *(Fig. 28.5. 4)* has a slag-like surface, which is presumably a refiring effect. Fabric is fine, and surfaces are well finished.

These objects range in height from about 4.5 to 6.5 cm; two examples were 6.7 and 7.3 cm high respectively. All the complete examples have a small perforation about 1 cm from the apex. These objects weigh little more than 100 g, and their perforations are 4–6 mm in diameter. The majority are more or less conical, broader at the base than at the top, and with slightly flattened faces and rounded sides *(Fig. 28.5. 1–7)*. A few are more drum-like *(Fig. 28.5. 8–9)*. Some have a rounded pear shape *(Fig. 28.5. 1, 4–5, 7)*. Tops are rounded or flat, but there is variation again throughout this small series. Many have a basal groove across their bases *(Fig. 28.5. 1–4, 7–9)*, although pieces with a flat base were also found.

Function

Their conventional interpretation as loomweights is attractive, and if accepted some kind of simple vertical or horizontal loom may be indicated (Makkay 2001). Similar objects from other Körös culture sites weighed from 46 to 141 g (Makkay 2001, 34). The atypical large clay weights *(Fig. 28.4. 4–6)* described above might be thought of as some kind of central weight for equipment of this kind, unless it has one or other of the functions discussed above.

Other evidence for weaving in the Körös culture has recently been summarised by Makkay (2001), with special attention to textile impressions on the base of pottery. As far as can be seen, textile impressions are from fibres of flax, hemp, willow or lime, and not of wool (Makkay 2001, 13–18; cf. Sherratt 1997). Makkay (2001, 8–9) has referred to bone pin-beaters, shuttles and needles, as secondary evidence for early textiles. As discussed by Alice Choyke in chapter 29, it is not clear whether the bone tools at Ecsegfalva 23 can be seen to have this kind of specialised function.

Waisted clay object

An unusual object *(Fig. 28.6. 1)* was found in the westernmost edge of the occupation deposit 464 in the North Extension, thus just outside the possible structure described and discussed in chapters 9 and 13. It was tripartite, with grooves or waisting producing slightly open ends and a central belly. There was a narrow central perforation. There are no obvious parallels in the published repertoire of clay objects of the Körös culture.

Discussion

With the exception of the last described object *(Fig. 28.6. 1),* these pieces thus fall directly within the normal repertoire of the Körös culture. If Ecsegfalva 23 were different from other occupation sites, as discussed throughout this report, this is not marked in the basic range of material culture. On the other hand, the quantity of such material seems rather restrained from Ecsegfalva 23, compared with other investigated sites, though it is obviously difficult to make direct comparisons given the respective sizes of the excavations.

We should note the interpretation of Chapman (2000), regarding the possible significance of fragmented figurines as part of the formalised enchainment of social relations, but given the limited extent of the excavations at Ecsegfalva 23 and the opportunities for normal breakage and attrition, this suggestion must remain untested.

Other clay objects: discs, beads, studs and balls

Among a variety of small fired clay fragments which are hard to classify, eleven pieces of more regular form could be distinguished.

Discs, spindle whorls

The finds from Ecsegfalva include three objects, which are quite obviously the fragments of flat, perforated clay discs. Two were cut from the body sherd of a clay vessel and had most likely functioned as spindle whorls *(Fig. 28.6. 3–4).* Makkay has found roughly one hundred spindle whorls on the Körös sites he investigated in the Körös valleys. Spindle whorls made using the same technique are known from Endrőd 35-Öregszőlők II (Makkay 1997, pl. II. 1), Endrőd 39-Szujókereszt (Makkay 1997, pl. I. 11), Endrőd 119-Öregszőlők (Horváth and Paluch 2005, 258, fig. 46–47; Makkay 1997, pl. I. 8–9, pl. II. 2–3, pl. III. 9, 12–16) and Szarvas 23-Egyházföld (Makkay 1997, pl. II. 4). At the latter site, objects of this type occurred together with white-on-red painted fragments supposedly representing the culture's earliest phase (Makkay 1997, 118). A few of these spindle whorls have unfinished perforations (Makkay 1997, pl. I. 1–7, 10, 12) or no perforations at all (Makkay 1997, pl. III. 4 –7).

The third fragment is plain on one side and decorated with incised lines on the other *(Fig. 28.6. 2)*. Its fabric differs from the chaff-tempered fabric of the other two pieces in that sand was also used as a tempering agent. It was perhaps intended as a disc, but its function cannot be unambiguously determined.

Beads

A larger, oval-sectioned clay bead *(Fig. 28.6. 5)* and a small rounded piece *(Fig. 28.6. 6),* with a tiny central perforation, were found at Ecsegfalva. The larger one comes from the upper part of the layer sequence in Trench A. In view of its fabric, it could equally date from the site's Early Neolithic or Middle Neolithic (AVK) occupation. The smaller one was found in the North Extension in Trench B.

Studs

Two small pear-shaped objects up to 1.8 cm long with flattened base were found in the North Extension in Trench B. One fragment *(Fig. 28.6. 7)* has a rather regular conical lower part and cylindrical upper part, of which little has survived. It was perhaps part of a larger, possibly cult object.

Balls

Four small clay balls (from 1 to 3.4 cm in diameter) were found, two from the occupation deposit in the North Extension in Trench B and two from Squares XY14–15 in Trench C. Their function remains elusive.

Discussion

Given their context, these small objects can be taken as part of a domestic assemblage. They could perhaps be thought of as small personal ornaments. Seeing that only a selection of the finds uncovered on the Körös sites investigated during more recent decades has been published, it is impossible to determine the frequency of similar small clay artefacts in the ceramic inventory from these sites.

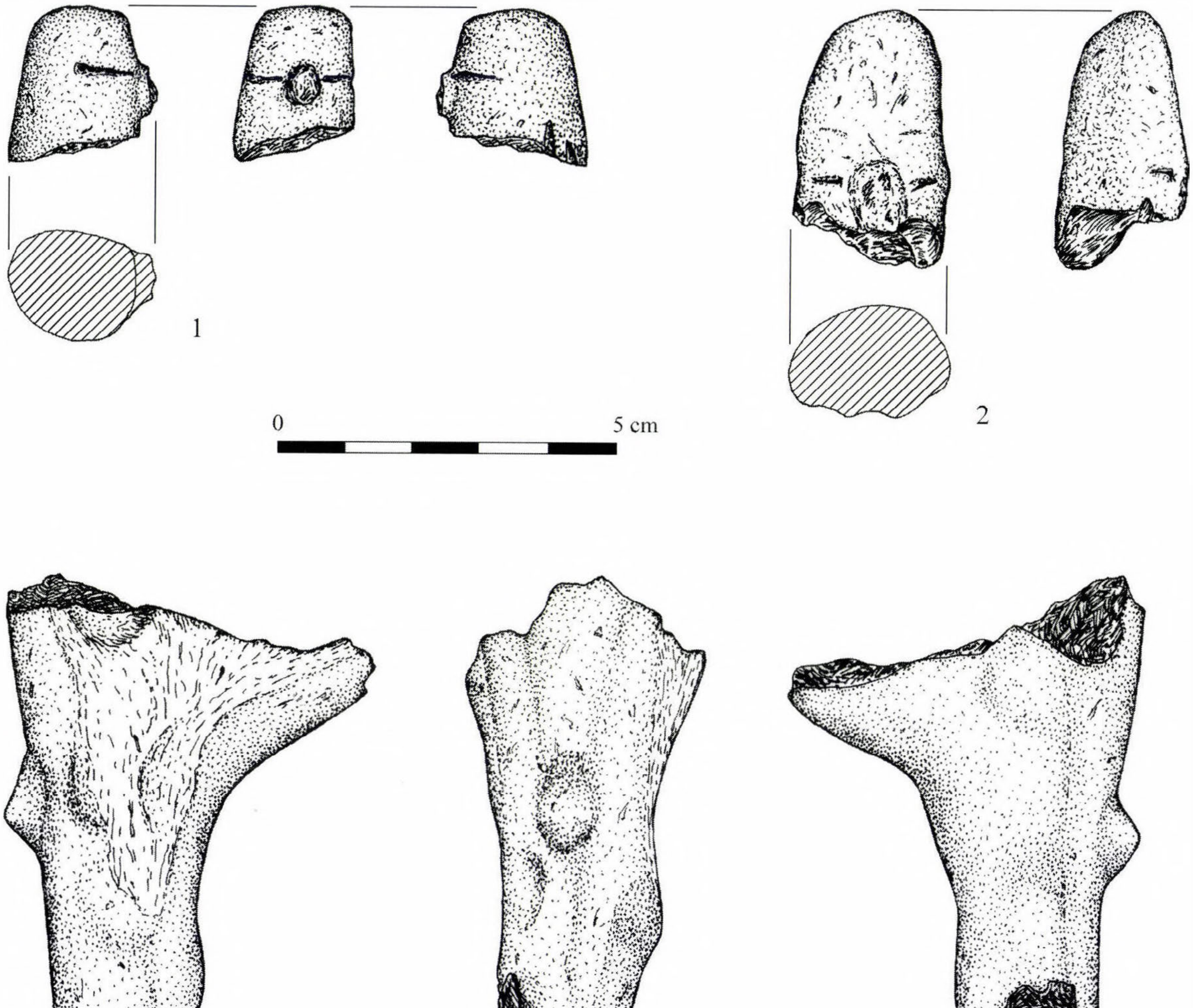


Fig. 28.1. Figurines and face pot (all drawings by T. Marton)

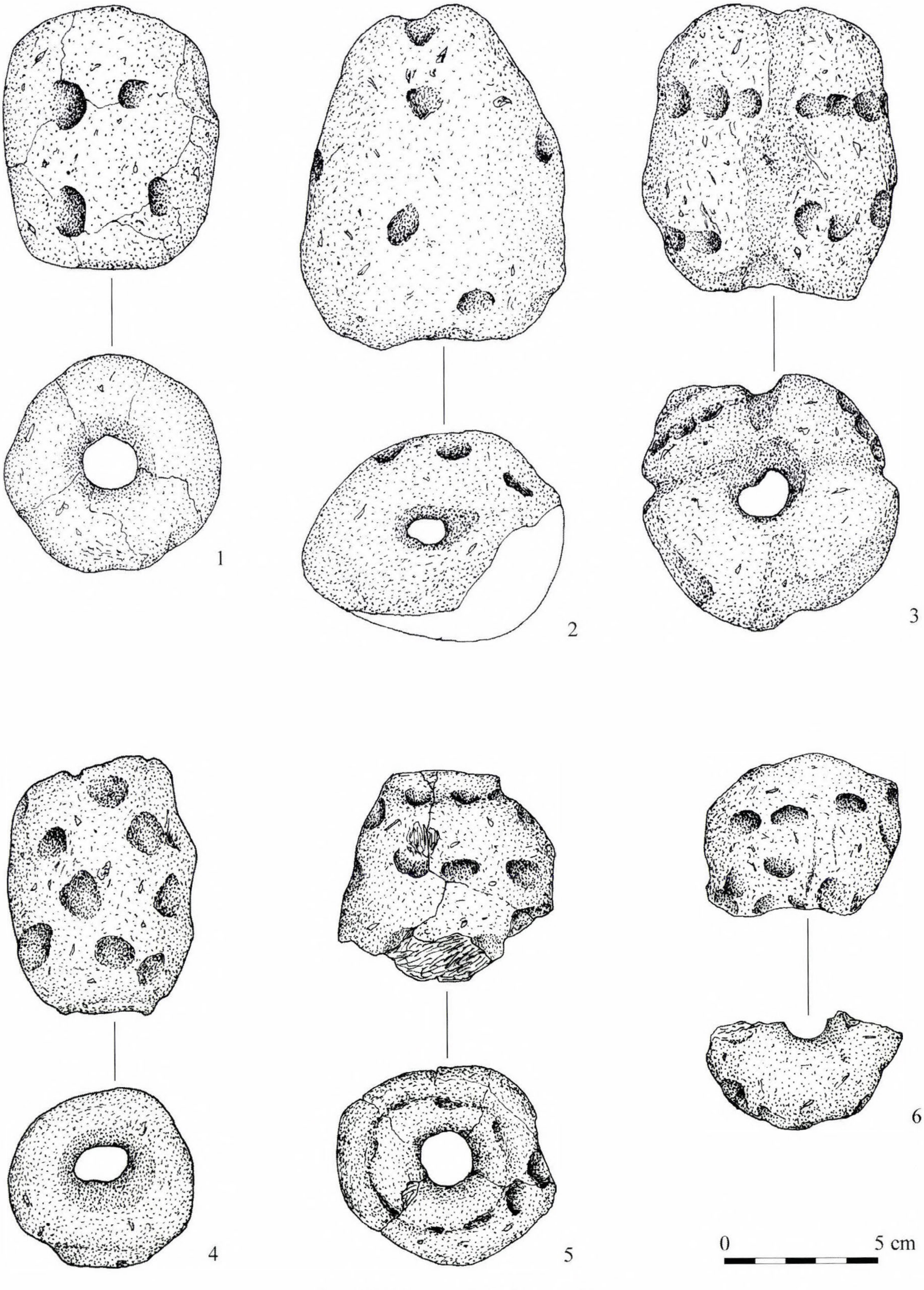


Fig. 28.2. Large perforated clay weights

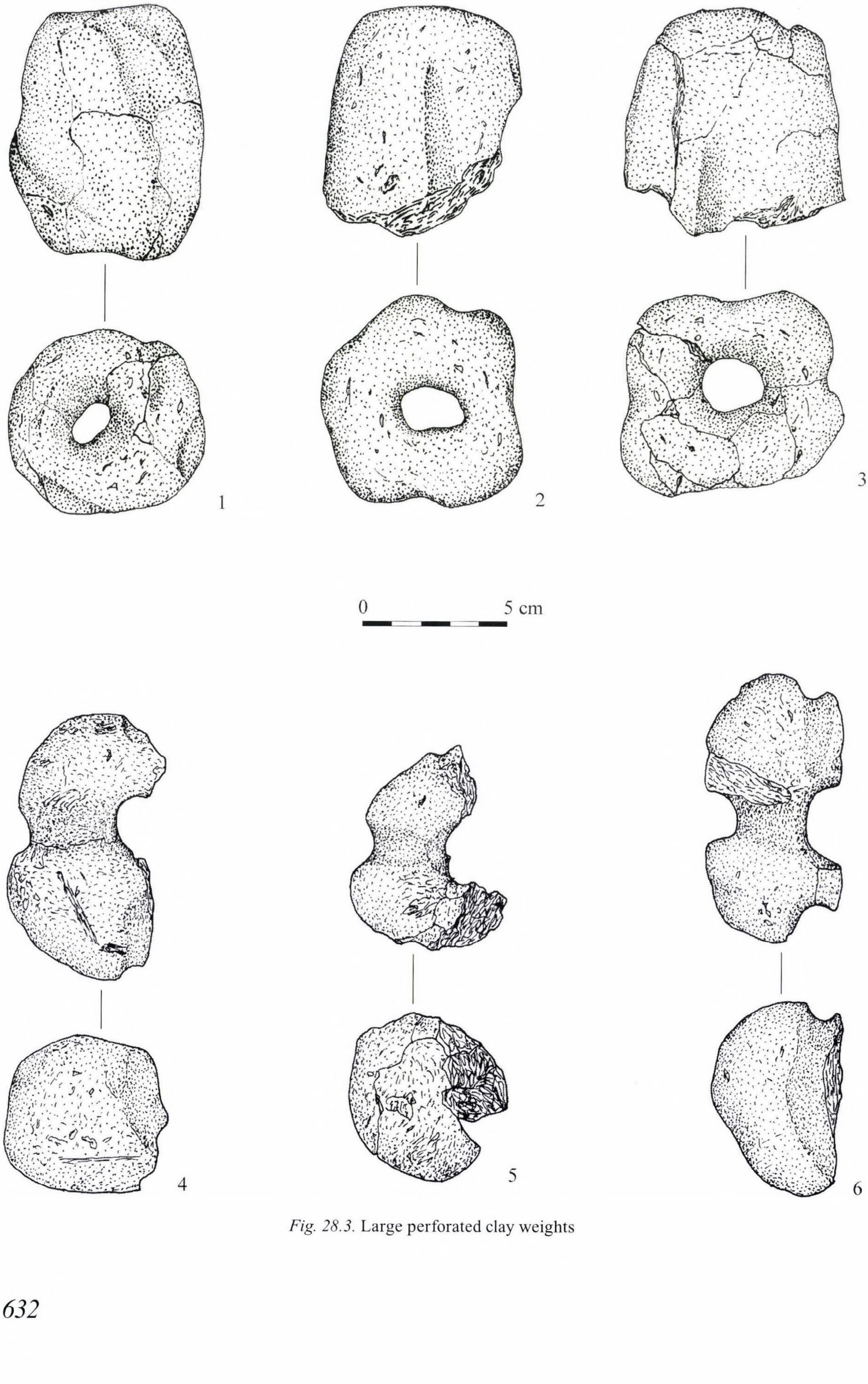


Fig. 28.3. Large perforated clay weights

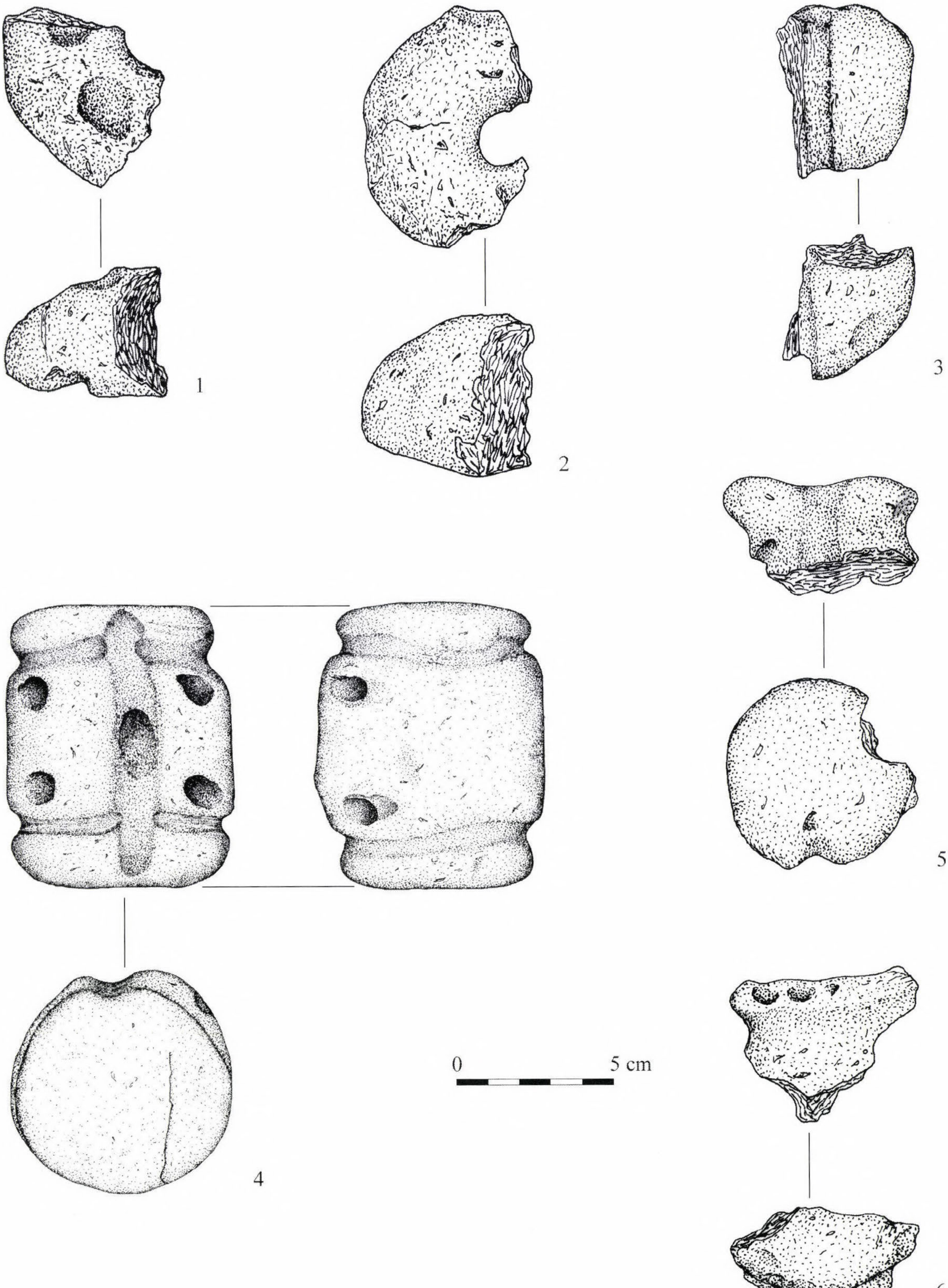


Fig. 28.4. Large perforated clay weights

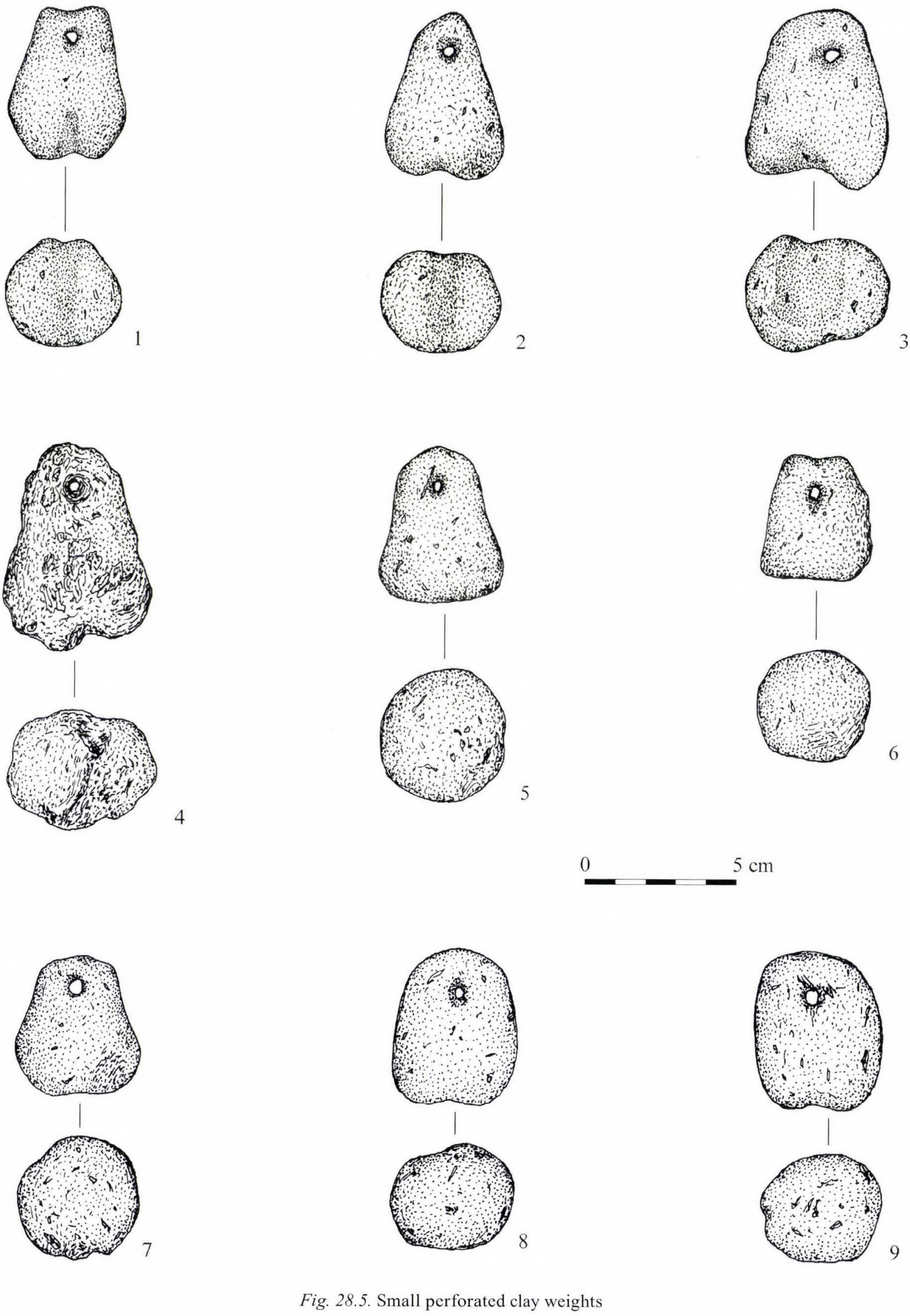


Fig. 28.5. Small perforated clay weights

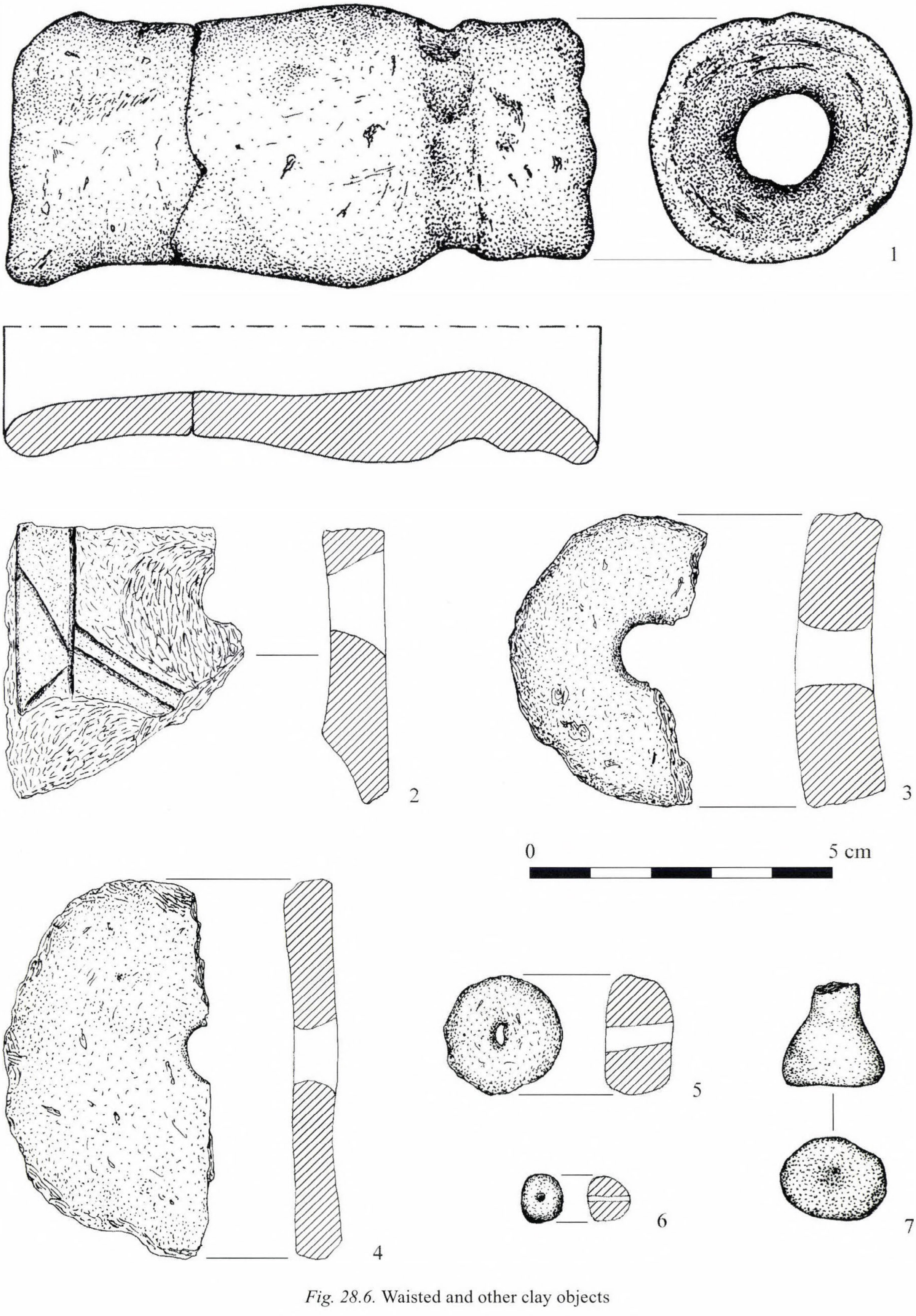


Fig. 28.6. Waisted and other clay objects

Appendix

Description of the artefacts shown in the Figures

The illustrations are depictions of three-dimensional objects in perspective projection. The scales on the Figures are approximate only; exact measurements are to be found in the Appendix.

Fig. 28.1. Figurines and face pot

1. Trench 23B, Context 313, Find no. 4270
Head fragment of a light brown and light grey coloured, chaff-tempered clay figurine. The top of the head is flat, the eyes are marked with two horizontal incisions. The appliqué nose has broken off. The head has a slightly oval cross-section. The figurine is broken under the stub of the nose. It most probably had a cylindrical trunk.
H. 2.2 cm, diam. 1.7 cm

2. Trench 23B, Context 342, Find no. 6137
Head fragment of a light brown and grey coloured, chaff-tempered clay figurine. The top of the head is rounded, the eyes are indicated with two horizontal incisions, the appliqué nose was set between the eyes. The originally perhaps conical nose has broken off. The head is flattened on the front and back side. The figurine is broken under the stub of the nose. The trunk was probably cylindrical. The surface is heavily worn.
H. 3.8 cm, W. 2.4 cm, Th. 1.9 cm

3. Trench 23B, Context 422, Find no. 11050
Fragment of a light brown and grey coloured, chaff and sand-tempered clay figurine. The fragment depicts the right foot and the lowermost part of the buttocks of a steatopygous figurine. The roughened surface on the left side shows where the left half of the buttocks was attached. The knee is indicated with a tiny knob. The front and back side of the broken foot widens, suggesting that it may have been oval.
H. 7.9 cm, diam. of foot 2.4 cm, L. of foot 2.9 cm, W. of foot 1.5 cm

4. Trench 23C, Context 521, Find no. 9569
Rim and neck fragment of a light brown, chaff-tempered anthropomorphic or zoomorphic vessel. The neck is funnel-shaped. The eyes are marked with horizontal incisions, of which the left one has survived completely, the right one partially. A conical, pointed knob indicates the nose.
L. 6 cm, H. 5.8 cm, dR. 12 cm, diam. of nose 2 cm, Th. 0.9 cm

Fig. 28.2. Large perforated clay weights

1. Trench 23B, Context 342, Find no. 6131
Light brown, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with impressions. Assembled from 22 fragments and restored.
L. 9.8 cm, diam. 7.4 cm, dP. 1.7 cm

2. Trench 23B, Context 445, Find no. 13151
Light brown, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with randomly spaced finger impressions. Restored.
L. 11.5 cm, W. 10 cm, Th. 8.5 cm, dP. 2.8 cm

3. Trench 23B, Context 376, Find no. 10033
Light brown, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with finger impressions in two rows and four lengthwise grooves. Secondarily burnt. Intact.
L. 11.5 cm, W. 10.4 cm, Th. 9.2 cm, dP. 2 cm

4. Found in surface survey
Brick red and grey, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with finger impressions. Intact.
L. 8.7 cm, diam. 6.1 cm, dP. 2.1 cm

5. Trench 23C, Context 539, Find no. 9663
Light brown, grey mottled, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with finger impressions arranged in rows. Assembled from eight fragments.
L. 7.3 cm, diam. 7.3 cm, dP. 2.1 cm

6. Trench 23B, Context 495, Find no. 14813
Fragment of a light brown, chaff-tempered, ovoid clay weight with a central perforation. The surface is decorated with finger impressions.
L. 6 cm, diam. 6.8 cm, dP. 1.7 cm

Fig. 28.3. Large perforated clay weights

1. Trench 23B, Context 464, Find no. 14387
Light brown, chaff-tempered, slightly ovoid clay weight with a central perforation. The surface is decorated with four curved, incised grooves. Assembled from 28 fragments and restored.
L. 9.6 cm, diam. 7.3 cm, dP. 2.2 cm

2. Trench 23B, Context 464, Find no. 14419
Light brown, grey mottled, cylindrical clay weight with a central perforation. The cross-section is slightly angular. The surface is decorated with lengthwise grooves. Assembled from four fragments.
L. 8.7 cm, W. 6.6 cm, Th. 6.5 cm, dP. 2.2 cm

3. Trench 23C, Context 524, Find no. 9423
Fragment of a light brown, grey and brick red mottled, chaff-tempered, cylindrical clay weight with a central perforation. The section is slightly angular. The surface is decorated with lengthwise grooves. Secondarily burnt. Assembled from 16 fragments.
L. 7.9 cm, W. 8 cm, Th. 7.4 cm, dP. 2.8 cm

4. Trench 23A, Context 147, Find no. 1704
Fragment of a light brown, chaff-tempered clay weight with a central perforation. The body was originally four-lobed, with the lobes separated by four symmetrically spaced grooves. Assembled from two fragments.
diam. 10 cm, Th. 6.1 cm, dP. 2.2 cm

5. Trench 23B, Context 343, Find no. 5809
Fragment of a light brown and brick red, chaff-tempered clay weight with a central perforation. The body was probably four-lobed, with the lobes separated by four symmetrically spaced grooves. Assembled from eight fragments.
diam. 7.7 cm, Th. 6.3 cm, dP. 2.1 cm

6. Trench 23C, Context 503, Find no. 9013
Fragment of a light brown, chaff-tempered clay weight with a central perforation. The body was probably four-lobed, with the lobes separated by four symmetrically spaced grooves. Assembled from two fragments.
L. 9.7 cm, Th. 6.9 cm, dP. 2.4 cm

Fig. 28.4. Large perforated clay weights

1. Found in surface survey, Find no. 2146
Fragment of a light brown, chaff-tempered, disc-shaped clay weight with a central perforation. Both sides are decorated with finger impressions.
L. 6.1 cm, Th. 4.6 cm

2. Trench 23B, Context 445, Find no. 13091
Fragment of a light brown, chaff-tempered, disc-shaped clay weight with a central perforation.
L. 7.6 cm, Th. 5.5 cm, dP. 2 cm

3. Trench 23B, Context 445, Find no. 13023
Fragment of a light brown, chaff-tempered clay weight. A deep groove runs across the surface.
L. 5.7 cm, W. 4.6 cm, Th. 4.1 cm

4. Trench 23B, Context 430, Find no. 11228
Brick red and dark grey, chaff-tempered, cylindrical clay weight. A groove encircles the circumference at each end and a shallow groove runs down the length of the body. There are two perforations perpendicular to the longitudinal axis. Intact.
L. 9.7 cm, diam. 7.4 cm, dP. 1 cm

5. Trench 23B, Context 344, Find no. 5940
Fragment of a light brown, chaff-tempered, cylindrical clay weight. A groove encircles the circumference at one end. The section of another groove parallel to the longitudinal axis survives on the body.
L. 3.8 cm, diam. 5.2 cm

6. Trench 23B, Context 354, Find no. 8692
Fragment of a light brown, chaff-tempered, cylindrical clay weight. A groove encircles the circumference at one end, whose edge is decorated with finger impressions.
L. 4.5 cm, W. 6.1 cm

Fig. 28.5. Small perforated clay weights

1. Trench 23B, Context 445, Find no. 13117
Light brown and dark grey, chaff-tempered, conical, slightly pear-shaped clay loomweight with a small perforation near the apex and a basal groove. Intact.
H. 5.2 cm, diam. 3.9 cm, dP. 0.6 cm

2. Trench 23B, Context 445, Find no. 13028
Light brown and reddish, grey mottled, chaff-tempered, conical clay loomweight with a small perforation near the rounded apex and a basal groove. Intact.
H. 5.6 cm, W. 4.1 cm, Th. 3.3 cm, dP. 0.6 cm

3. Trench 23B, Context 464, Find no. 14229
Light brown and reddish, chaff-tempered, conical clay loomweight with a small perforation near the rounded apex and a basal groove. It appears to be secondarily burnt. Intact.
H. 6.3 cm, W. 5 cm, Th. 4.2 cm, dP. 0.6 cm

4. Trench 23B, Context 445, Find no. 13123
Reddish, chaff-tempered, conical, slightly pear-shaped clay loomweight with a small perforation near the rounded apex and a basal groove. Secondarily burnt with a slag-like surface. Intact.
H. 7.3 cm, W. 4.8 cm, Th. 4.3 cm, dP. 0.4 cm

5. Trench 23B, Context 445, Find no. 13034
Light brown and dark grey, chaff-tempered, conical, slightly pear-shaped clay loomweight with a small perforation near the apex. Intact.
H. 5.4 cm, diam. 4.2 cm, dP. 0.6 cm

6. Trench 23B, Context 445, Find no. 13131
Dark brown and dark grey, chaff-tempered, conical clay loomweight with a small perforation near the flat apex. It appears to be secondarily burnt. Intact.
H. 4.6 cm, diam. 3.8 cm, dP. 0.5 cm

7. Trench 23B, Context 422, Find no. 11044
Light brown, chaff-tempered, pear-shaped clay loomweight with a small perforation near the flat apex. Intact.
H. 4.9 cm, diam. 4 cm, dP. 0.6 cm

8. Trench 23B, Context 469, Find no. 14441
Light brown and dark grey, chaff-tempered, cylindrical clay loomweight with a small perforation near the rounded apex. Intact.
H. 5.6 cm, W. 4 cm, Th. 3.6 cm, dP. 0.6 cm

9. Trench 23B, Context 422, Find no. 11046
Light brown, dark grey mottled, chaff-tempered, cylindrical clay loomweight with a small perforation near the rounded apex. Intact.
H. 5.3 cm, W. 4.2 cm, Th. 3.7 cm, dP. 0.6 cm

Fig. 28.6. Waisted and other clay objects

1. Trench 23B, Context 464, Find no. 13564
Light brown, chaff-tempered, cylindrical clay object with a central perforation. It is divided into three parts by a deeper and a shallower groove. Assembled from three fragments and restored.
L. 9.8 cm, diam. 4.1 cm, dP. 2 cm

2. Trench 23B, Context 461, Find no. 13104
Fragment of a light grey, dark grey mottled, chaff and sand-tempered clay object with a perforation. The surface is decorated with incised lines on one side. Probably a fragment of a clay disc.
L. 4.3 cm, W. 3.9 cm, Th. 0.7 cm, dP. 1.3 cm

3. Trench 23B, Context 314, Find no. 4553
Fragment of a light brown, grey mottled, chaff-tempered, perforated clay spindle whorl, cut from the body of a clay vessel.
diam. 4.7 cm, Th. 1.3 cm, dP. 0.8 cm

4. Trench 23B, Context 340, Find no. 6206
Fragment of a light brown, dark grey mottled, chaff-tempered, perforated clay spindle whorl, cut from the body of a clay vessel.
diam. 6.3 cm, Th. 0.7 cm, dP. 0.7 cm

5. Trench 23A, Context 102, Find no. 1023
Light brown and grey coloured, flattish, chaff-tempered, perforated clay bead. Intact.
diam. 1.8 cm, Th. 0.8 cm, dP. 0.3 cm

6. Trench 23B, Context 445, Find no. 11617
Light brown and grey coloured, rounded, perforated clay bead. Intact.
diam. 0.9 cm, dP. 0.1 cm

7. Trench 23B, Context 321, Find no. 4578
Fragment of a light brown, chaff- and sand-tempered clay object with cylindrical upper and conical lower part.
L. 1.7 cm, diam. 1.6 cm

Abbreviations

L.: length
W.: width
H.: height
Th.: thickness
diam.: diameter
dR.: diameter of rim
dP.: diameter of perforation

Appendix Table 28.I. Quantities of perforated clay weights from the main areas of 23B

Area	Number of clay weights
N and W Extensions	104
Other boxes, uppermost spit (301)	19
N Box	20
C-W Box	12
C-E Box	5
S-W Box	12
S-E Box	4
Pit 390	13

Chapter 29

OBJECTS FOR A LIFETIME – TOOLS FOR A SEASON: THE BONE TOOLS FROM ECSEGFALVA 23

Alice M. Choyke

Introduction

The way people choose raw materials, manufactured and used objects made from various osseous materials may have both general and culturally idiosyncratic elements. Although it might be thought that the forms of bone tools would be limited by the natural shapes of the raw material, in fact, each prehistoric bone tool assemblage brings its own surprises. The choices made with respect to manufacturing and use, represent both culturally determined behavior and individual decisions. Beyond typo-chronological questions within regions, understanding variability in this class of artifacts can provide insight into group identity from the household to intra-regional level. As explicitly cultural artifacts, bone tools also reflect attitudes towards the tasks they were employed in as well as attitudes toward the animals which provided the bones and finally, offer glimpses into the daily lives of the people who produced and used them.

Serious long-term work on the form of bone tools and their raw material began in the 1970's (Camps-Fabrer 1974; 1979; 1982; 1985; Schibler 1981; Choyke 1984). The great difficulty of bone tool reports being buried in the back of inaccessible site reports now seems to be more a thing of the past as communication between interested scholars improves. Much has been learned in the past thirty years about bone, antler and tusk manufacturing in both prehistoric and historic contexts (MacGregor 1985; Becker 2003). To a much more limited extent, work has also been carried out on the more problematic questions surrounding types of use wear. Today, identification of function is most often based on either analogy to ethnographically known types of bone tools and ornaments, clearly identifiable macro-wear (Olsen 1984; Campana 1989; Jensen 2001; Schibler 2001) and, more recently, micro-wear studies at high magnifications. Micro-wear research demands well-preserved assemblages, expensive metallurgical or electron microscopes and, above all, time to carry out experiments and blind-testing to develop a range of recognizable wear patterns for particular assemblages (Olsen 1984; Plisson 1984; LeMoine 1989; 1997; Griffitts 2001). Thus, at the moment, microwear studies remain limited to a few laboratories and researchers.

Variables characterising worked osseous materials

Variability in worked osseous materials may be expressed within a number of categories:

1. *Species preferences or avoidance.* Species preferences normally reflect availability within the faunal assemblage. Avoidance or overuse relative to the proportion of the same species in the refuse bone assemblage signals cultural attitudes towards the particular kind of animal.
2. *Use of particular skeletal elements.* Although some skeletal elements from large and small ruminants such as the long bones regularly appear in worked bone assemblages, their propor-

tions may vary. Their numbers may co-vary with their proportions in the food refuse, thus, reflecting butchering patterns and availability. Skeletal elements may be worked based on deliberate choice related to explicit manufacturing traditions. Where available, tusk and antler are almost always exploited, although to varying degrees. Tools may also be manufactured from non-selected bones, manufactured on an *ad hoc*, non-planned basis.

3. *Different kinds of manufacturing techniques.* Much of prehistoric bone and antler manufacturing was carried out using chipped stone tools and grinding surfaces. Manufacturing techniques used at Ecsegfalva 23 include cutting, splitting, sawing, scraping and abrasion. Drilling represents another important, although less common, technique.
4. *Variation in the care used to produce tools.* The manufacturing continuum (Choyke 1997a; 2001) refers to the degree of planning that goes into the manufacture of a particular tool type. Tools of identical function may be made quickly, in an *ad hoc* manner, or in a series of carefully planned steps reflecting the importance of the task the tool was to be used in for the individual craftsperson. Such general attitudes are characteristic of particular sites or groups of sites. Variables used to assess tool quality include the degree of regularity in the choice species/bone element used in tool manufacture, the number of manufacturing steps and the proportion of tools which display signs of re-working.
5. *The use(s) to which bone objects are put.* In prehistoric worked bone assemblages, tools tend to be less specialised. An awl may be simultaneously used for basketry or perforating hides for sewing. Later as tools are re-worked and become smaller they may be transformed into totally different kinds of objects. These transformations often occur in a regular way. For example, massive points are frequently transformed into bevel-ended tools, used in a more spur of the moment way. At this site there is one example of a rib double-point where the tips broke off and the broken edges were transformed into beveled-ends for polishing or scraping rather than piercing.
6. *The care with which the tools and ornaments are conserved through re-working.* While some re-working may always be found in bone tool assemblages there are differences in the degree of curation found in individual assemblages. Some groups conserve their tools until they become too small to use easily. This process of use and re-working may actually last longer than one person's lifetime. Other groups barely conserve their tools, discarding them when they break. Usually, this kind of behaviour is more typical when the tools themselves are less carefully manufactured and produced from readily available raw materials. Some tools probably were closely associated with the individuals using them. Thus, sometimes tools and ornaments may have been abandoned or taken out of circulation before the end of their useful life for reasons including the death of the owner.
7. *The end of the working life of a tool when it is finally discarded.* The acceptable time to discard a tool or ornament depends on the tool type, what is customary within the particular societies where the tool type was used. Finally, discard practice is also a matter of individual choice.

At present, although most bone tool studies deal with all these questions to varying degrees, this more complete approach is a very recent development. Nevertheless, despite these advances in methodology, difficulties still remain. First, most use wear studies are by their very nature particular to the assemblages analysed. Use wear pattern collections need to be developed on a regional basis. It would not be legitimate to transpose data directly between regions such as France and the Carpathian Basin. Furthermore, relatively few bone tool assemblages were analyzed following these rules. The paucity of comparative data makes comparisons between assemblages, a cornerstone of archaeological research, very difficult. In fact, the database for assemblages of bone tools is still lamentably small. The Starčevo-Körös-Criş cultures, an early farming complex of the Carpathian Basin and the Northern Balkans, is widely distributed and encompasses a long time span (500 plus years). Therefore, the scattered reports available (Sterud and Sterud 1974; Makkay 1990a; Beldiman 2000; 2001; 2002) make the present material from Ecsegfalva 23 difficult to place within a broader cultural context.

The bone tool material from this site is especially important owing to the recovery techniques used during the excavations. The very careful excavation yielded 98 bone tools from a relatively very small territory. All soil from Ecsegfalva 23 was screened and in some cases subjected to even finer sampling with flotation. To put these numbers in perspective, the much larger and extensive excavations at Körös and Criş sites in Hungary and Romania where hand-collection is the norm yielded assemblages which were smaller or of comparable size. For example, the 30 years of excavation at Trestiana yielded slightly 'plus de 100 objets' (Beldiman and Popuşoi 2001, 377). In addition, under these rougher excavation conditions, larger and more specially shaped tools and ornaments tend to be collected. Well-worn tools, with their glossy surfaces and often honey brown color, also tend to be more noticeable during excavation. Thus, it has also proved hard to compare bone tool assemblages from various sites because tool inventories are often distorted by sampling bias.

The disadvantage of the very fine excavation techniques was that time was too limited to expose larger areas. Thus, it proved impossible to do much analysis of the spatial distribution of bone tools within the site, that is, contextualise the Ecsegfalva 23 finds relative to distinct features such as houses and pits. Therefore, with the exception of some ring debris and a more detailed examination of the category of complete, unbroken tools, no attempt was made to further subdivide this sample by context.

Location of the site

The Early Neolithic settlement of Ecsegfalva 23, is a small site located by a water channel slightly east of the Körös river on the Great Hungarian Plain (*Figs 1.3* and *9.6*).

The small settlement lay on a slight rise in an otherwise flat, swampy mosaic landscape interspersed with forest steppe. The surrounding area must have been subject to continuous flooding (see Sümegi and Molnár, chapter 5). The question of whether this site represents permanent settlement or was simply a 'station' in a general pastoral round is still undecided. However, the weight of the environmental evidence suggests some level of continuous occupation throughout the year (see Bogaard *et al.,* chapter 23).

The manufacturing continuum

Tools and ornaments from Ecsegfalva 23 have been classified according to where they lie along what has been called elsewhere the manufacturing continuum (Choyke 1997a; 2001). At one end of this continuum are elaborate, planned, carefully made tools. Transitional bone artifacts, less complex in terms of their manufacture but made in strongly stereotypic ways relative to the choice of raw material, lie somewhere in the middle of this continuum and may be termed Class I–Class II tools. Finally, at the other extreme of the continuum are the Class II objects made from bones which broke in lucky ways and used with little or no manufacturing. Such tools must have been used for single tasks and were soon discarded. There were five worked objects which either represent debris or which were too fragmented to determine how intensively the original tool had been worked.

The 49 (59 with the debris from making one type of Class I rings) Class I tools represent objects made from specially selected raw materials. They were produced in several planned stages, displaying uniformity in their technical style. They were often intensively used and carefully curated by their users. It is also suggested here that the users of these tools were actually

Table 29.1. Frequencies of three classes of tool types at Ecsegfalva 23

Class I	Class I – Class II	Class II	Not Available
49 (+10 pieces ring-making debris)	30	4	5

owners in the sense that these objects would have been strongly associated with individuals. The question of ownership is particularly relevant for the more elaborate tools which were discarded when still usable. There are many ethnographically documented groups where objects made of special materials may take on powers of their own, related to the people using them. Mauss ([1950] reprinted 2004, 56–57) describes what may be an analogous situation for the Kwakiutl of the north-west coast of North America:

> 'Each one of these precious things possesses, moreover, productive power itself. It is not a mere sign or pledge; it is also a sign and pledge of wealth, the magical and religious symbol of rank and plenty. The dishes and spoons used solemnly for eating and decorated, carved and emblazoned with the clan's totem or the totem of rank, are animate things [...] They are themselves deemed to have fairy-like quantities.'

In the case of the small farming societies of the Körös culture, elaborate, decorated objects made from wood, hide, basketry or textiles have not survived. However, certain elaborate Class I bone objects may have lasted throughout the lifetimes of their owners – longer than the settlements themselves were occupied – and certainly long enough to become closely associated with their makers and users.

In this regard, it is clear that bone tools can have very long use lives. I have documented bone hair comb use in a village in Transylvania where women traditionally used their combs for up to 20–30 years. One woman reported that she carried her comb with her to Budapest where she now worked as a reminder of where she was from. Further, there are examples of simple tools being used for long periods which also take on special meaning for their users. For example, there is a bevel-ended tool made from a cattle metapodium which was used for thirty years (is still being used) by a pair of Bulgarian shoe-makers. This tool had come to some extent to represent their professional life together (Choyke 2006a).

Of particular interest in this regard at Ecsegfalva 23 may be the caprine metapodium awls (Schibler 1981, Type 1/1), metapodium pins with their epiphyses ground flat, spoons, massive 'hooks' and possibly rings. These are also special types which are particularly associated with the find material of the Starčevo-Körös-Criş culture for at least 600 years. Thus, their manufacture must somehow also be associated with a constructed folk memory past.

Another important category of Class I bone tools at Ecsegfalva, the double-points made from long bone and (mainly caprine) rib, tend to be more fragile and therefore not so long lasting. These tools are curated, usually with grinding, but are less intensively utilized than the most elaborate kind of Class I tools at this site. One exception is a large 'netting' needle as well as two more massive double points from cattle-size long bones which display heavier use and handling polish than the fine rib double points.

The 30 transitional Class I–Class II objects tend to be made from regularly selected raw materials, but display more simple modifications without multi-stage manufacturing. Most of the perforators made on long bone diaphyses (excepting Schibler's 1/1 small ruminant metapodium perforators) and bevel-ended tools made from long bone diaphyses and ribs, fall into this category. Usually the only modifications in this class of tool are found at the working end. Some of these objects were intensively used and re-worked as the tip or edge broke. A nice example of a tool which falls between the two extremes of the manufacturing continuum are two large cattle ribs, each with a single wavy beveled edge but which are otherwise unmodified. One of these tools appears to have been repeatedly reworked.

Finally Class II tools, barely modified from serendipitously broken pieces of bone, are made into both massive and small *ad hoc* perforators and bevel-ended objects with almost no modification.

Curation

Altogether 70 pieces of bone tools were complete enough to estimate whether they had been reworked. A tool was considered re-worked when the manufacture wear at the working end was fresher (the edges of the striations appear sharper under the microscope) than the use wear below it. Slightly less than half of the tools were curated (N = 33 or 47%) and more than half were more temporary in nature, that is, made and used at the settlement, broken and finally discarded after no more than a couple of years or even less (N = 37 or 53%). Typically, Class I tools are curated. For example, metapodium awls (N = 15) would be almost always re-worked. Similarly here, as elsewhere (Makkay 1990a, 24–27, 30; Popuşoi and Beldiman 1993–1998), bone spoons can be seen to have undergone continuous regular curation as they were used. However, not all tools, even when elaborately worked, were curated. Thus, when massive hooks broke they were not repaired as generally they broke in such a way that they could not be used for anything else. Typically for prehistoric worked bone assemblages, there are objects which are not only curated but are eventually re-worked into different types of tools. Most common in this regard are perforators turned into bevel-ended tools. Curation at Ecsegfalva 23 was mostly carried out using scraping with chipped stone blades although there was some re-grinding of edges and points. The dominance of scraping is not surprising, given the lack of abrasive stone in the environment. Heavy pieces of sandstone would have been harder to haul around from village site to village site.

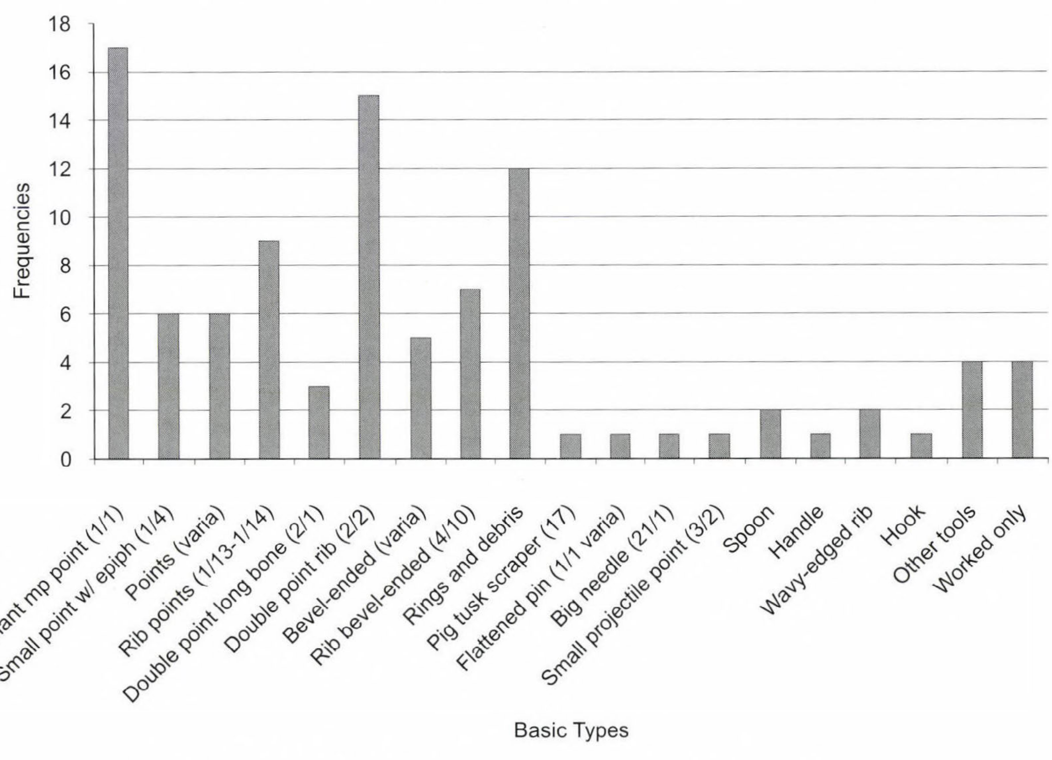


Fig. 29.1. Distribution of tool and ornament types at Ecsegfalva 23

Definition of Types

Because so little has been written about Early Neolithic bone working anywhere in the Carpathian Basin and eastwards into Bulgaria and Turkey, it is useful to present a precise definition of the type of bone and tusk tools found at this well excavated site as an aid to future comparative research. The type numbers listed here are largely derived from types published by Schibler (1981) and expanded by researchers at the University of Basel Bioarchaeology laboratory on the basis of Neolithic assemblages from lake-dwellings in Switzerland (Bartosiewicz and Choyke 1994; Schibler 1997; 1998; Deschler-Erb *et al.* 2002). Because of the amazing preservation of organic materials at these sites, these assemblages represent what must be the most complete range of Neolithic tools and ornaments available in continental Europe.

The main morphological types defined at Twann (Schibler 1981, 19) occur in the Carpathian Basin as well, although the choice of raw materials and manufacturing techniques differs from place to place and through time. Schibler's typology is retained to facilitate comparisons between areas. New types are added using similar criteria of form, raw material categories and size.

Measurements will be given for individual type specimens or measurement ranges for more numerous, measurable types.

Table 29.2. Frequencies and percentages of bone types at Ecsegfalva 23

General Types	Number	%
Small ruminant metapodium point (1/1)	17	17.30
Flat-ended pin (1/1 varia)	1	1.00
Small point w/ epiphysis (1/4)	6	6.00
Small points (varia)	5	5.20
Large point (1/9)	2	2.00
Rib points (1/13–1/14)	9	9.20
Double point – long bone (2/1)	3	3.10
Double point – rib (2/2)	15	15.30
Small projectile point (3/2)	1	1.00
Massive bevel-ended tool (4/3)	2	2.00
Small bevel-ended tool (4/5)	2	2.00
Thin slender bevel-ended tool (4/9)	1	1.00
Rib bevel-ended tool (4/10)	7	7.30
Spatula (12)	1	1.00
Pig tusk scraper (17)	1	1.00
Large needle (21/1)	1	1.00
Spoon	2	2.00
Hook	1	1.00
Ring and 'plug-shaped' ring debris	7	7.30
Rings and cortical debris	5	5.20
Handle	1	1.00
Wavy-edged rib	2	2.00
Humerus	1	1.00
Blank	1	1.00
Worked fragment (22)	4	4.10
Total	**98**	**100.00**

GL = greatest length in mm
GB = greatest breadth in mm
GD = greatest depth in mm
Ltip = Greatest width to extreme tip in mm
Btip (taken 5 mm from extreme tip) = breadth tip in mm
Dhole = diameter of hole in mm
* = estimate

Compared to the assemblages of worked bone, antler and tusk from the Körös culture sites of Endrőd 35 and Szarvas 23 described by Makkay, the typological variability within and between tool classes is lower at Ecsegfalva 23 *(Fig. 29.1)*. From a statistical point of view, this greater variability would be expected because the sample size at Ecsegfalva 23 is relatively small (N = 98). Makkay (1990a) described over 600 objects, over six times greater than what came to light at this small site. In addition, there may be differences, not yet evident in the nature and complexity of these various settlements, affecting the frequency of particular types. On the other hand, it is possible that the recovery rate of (especially) smaller artifacts from Ecsegfalva 23 is much greater relative to coeval sites excavated in the surrounding territories. A very low rate of recovery may be presumed for worked bone from Criş sites (Marinescu-Bâlcu and Beldiman 1997; Beldiman 1999–2000; 2000; 2002), some of which were excavated for around thirty years (1964–1996). Such differences reflect the exceptionally careful and fine excavation techniques employed at Ecsegfalva 23, especially the beneficial effect of screening and water sieving.

Type Descriptions

1. Small ruminant *metapodium perforators* (*Class I; Schibler types 1/1 and 1/2, Makkay types XIII–XIV, Beldiman type DVM 4*) with epiphyseal ends retained. *N = 17. (Figs 29.2a–b, 3, 4, 5): (GL = 42.9–69.7 mm, GB = 12.0–14.7 mm, GD = 8.2–11.0 mm, Ltip = 46.8–68.1 mm, Btip = 0.8–1.0 mm*). These tools represent a 'classic' type since they are found on virtually all prehistoric sites from all periods where small ruminant bone was worked into tools. Metapodial bones are available for working as they contain relatively little marrow (and are thus less likely to be broken up) and have hardly any meat on them. On the other hand, because they are straight and naturally divided along the fusion line between the 3rd and 4th metapodium, skillful workers can potentially break them into four usable pieces to work into perforators, taking advantage of their natural fracturing qualities (Murray 1979, 28). Most typically, the condyle of the distal epiphysis is retained as a handle. During manufacturing, the bones are first grooved completely through the cortical bone of the diaphysis as well as the epiphysis (Clark and Thompson 1953). This style of manufacture is characteristic of the Neolithic, including the late Neolithic, in the Carpathian Basin, although the use of this bone tool type tails off in subsequent periods.

   The specimens from this site in particular are heavily curated down to 'pencil stubs'. This situation stands in contrast to observations made in the later Neolithic of the same region when such awls occur in a great variety of sizes, ranging from long, new ones down to the pencil-stub size awls (e.g. Choyke 1997b). Several of the 1/1 awls were discarded at this site, as at other Körös and Criş sites (Makkay 1990a, fig. 10. 7; Beldiman 1999–2000, fig. 2), with intact tips, in a still usable condition. The use life of such tools would have

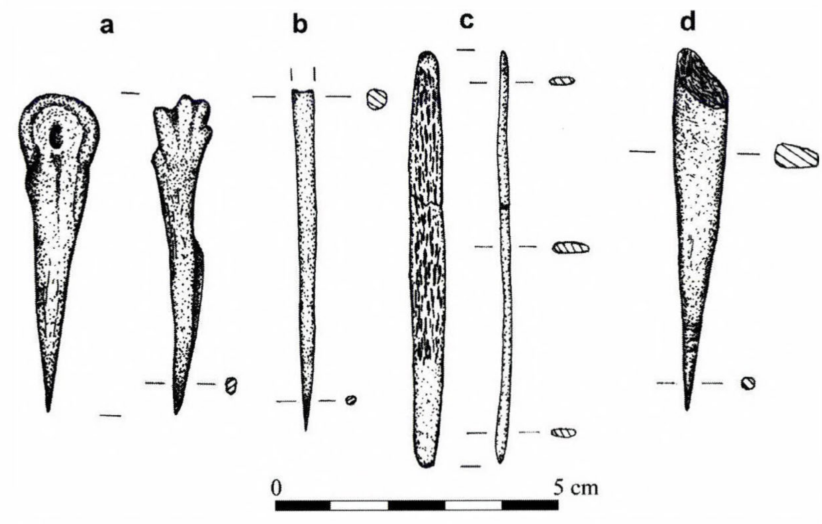


Fig. 29.2. Drawings of main pointed tool types: a. small ruminant metapodium perforator (Schibler 1/1); b. possible small ruminant metapodium perforator (Schibler 1/1?), broken with fine tip extant; c. small bevel-ended tool reworked from double pointed rib tool; d. large point without epiphyseal end from cattle-size ulna (all drawings by T. Marton)

Fig. 29.3. Heavily curated 'pencil-stub' small ruminant metapodium perforator (Schibler 1/1), discarded after tip broke, sheep metatarsus

Fig. 29.4. Heavily curated 'pencil-stub' small ruminant metapodium perforator (Schibler 1/1), caprine metatarsus with separated distal epiphysis

been many years, certainly outliving the duration of individual settlements if we assume they were not occupied for more than a few years at a time. Perhaps such tools, requiring planning, multi-stage manufacture and amenable to continuous re-working, were closely associated with individuals and discarded on the death of their owner (Choyke 2006b) (*Figs 29.2a,* possibly *2b, 3–4*).

2. Small ruminant *metapodium perforator with ground flat distal epiphysis* (*Schibler type 1/1 varia, Makkay type XIII*). *N = 1. Class I tool type (Figs 29.6, 13a):* (*GL = 67.8 mm, GB = 10.0 mm, GD = 10.0 mm, Ltip = 63.4 mm, Btip = 0.9 mm*). This decorative pin is one of the marker types of the Early Neolithic Starčevo-Körös-Criş complex (Sterud and Sterud 1974; Makkay 1990a, 39, fig. 10. 1–2, 4–6, 13–16). As opposed to the previous type of awl, the dorso-ventral faces of the caprine metatarsus diaphysis and distal epiphysis are ground flat to varying degrees (Poplin 1974; Murray 1979; Stordeur 1979; Beldiman 2002, fig. 4). The head of the pin is created by the profile of the distal epiphysis although some of the pins found at Endrőd 35 (Makkay 1990a, fig. 10. 13) are more refined looking than this object. The entire surface of this specimen shows polish wear from contact with a soft material. It has been repaired but was discarded while still considerably longer than any of the 1/1 awls *(Fig. 29.7).* While this technique is strongly associated with the Körös culture and later disappears in the Hungarian Plain, examples of such pins can still be found on Neolithic sites in the plain to the south of the modern political border (Russell 1990).

3. Small long bone *perforator* based on spiral fracture of the diaphysis but with epiphysis (*Schibler type 1/4, Makkay type X*). *N = 6. Class II tool type* (*no measurements available*). These perforators are made from pieces of caprine long bone broken for marrow,

Fig. 29.5. Comparison of two varieties of small ruminant metapodium perforator (Schibler 1/1 and 1/1 *varia*), both from sheep metatarsus: a. longer pin with distal epiphysis ground flat (Schibler 1/1 *varia*); b.'pencil-stub' metapodium perforator (Schibler 1/1)

with the sharp end of the spiral fracture providing a natural tip, further sharpened and one of the epiphyses retained. The six specimens from this site all fall towards the Class II, expedient category. This exemplifies the lack of care generally put into manufacturing most of these tools. Such perforators display minimal curation and only moderate wear, consistent with a more casual use. This is a tool type known from most prehistoric periods in the Carpathian Basin.

4. *Large ulna perforator* (*Schibler type 1/5, Makkay type XVI*). *N = 1. Class II tool* (*no measurements available*). This large *ad hoc* perforator was made from a cattle ulna. The olecranon was broken off and the tool was barely modified towards the tip. This is a tool type, sometimes quite carefully worked, which can be found on most Neolithic sites in the Carpathian Basin with manufacturers taking advantage of the natural shape of this skeletal element. Here, however, it is considered Class II because it does not seem to be common in other Körös bone tool assemblages (Makkay 1990a). In addition, the bone used to manufacture this tool was broken during butchering and barely modified.

Fig. 29.6. Close-up of flat ground surface of distal epiphysis (Schibler 1/1 *varia*) creating a more decorative end for this metapodial based pin

5. *Large perforator* without epiphyseal end (*Schibler type 1/9, no Makkay type*). *N = 2. Class I–II (Fig. 29.2d):* (*no measurements available*). There were only two such perforators recovered from this site, one made from a long bone diaphysis splinter of a cattle-size animal and the other possibly made from an ulna diaphysis of another large ungulate. These tools fall in the middle of the manufacturing continuum but towards the Class II end. Neither specimen is particularly well made. However, their tips are well formed and show signs of having been curated. In general, perforators at this site tend to be on the small side and be made from caprine bones. This tool type can be found on most prehistoric sites of all periods in the Carpathian Basin.

6. *Large rib perforator* (*Schibler type 1/13, no Makkay type*). *N = 3. Class I–II (Fig. 29.10a):* (*L = 74.0 mm, GB = 7.6 mm, GD = 4.0 mm, Ltip = not available, Btip = not available*). These perforators were made from

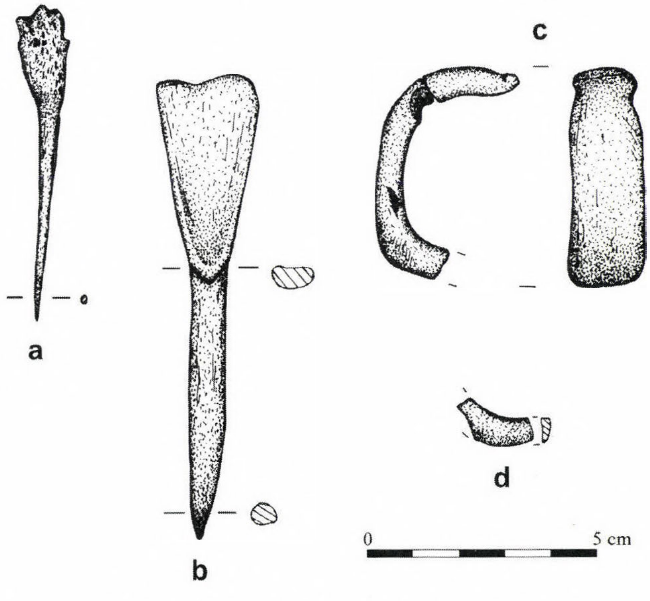


Fig. 29.7. Elaborated Class I pointed tool types:
a. pin with distal epiphysis ground flat (Schibler 1/1 *varia*);
b. cattle or aurochs metatarsus based spoon with V-shaped bowl base; c. two views of fragmented massive hook d. fragment of tusk ring

split cattle-size rib corpus. The bone compacta was removed on one side and the spongiosa smoothed creating a thin surface ending in a point. Only one is complete. One specimen was intensively used, probably reworked from a rib scraper, giving it a honey brown color. The other two specimens have eroded surfaces from weathering and are badly fragmented.

7. *Small rib perforator* (*Schibler type 1/14, no Makkay type*). *N* = *4. Class I* (*L* = *70.0,* GB* = *7.7–8.0 mm, GD* = *2.9–3.3 mm, Ltip* = *not available, Btip* = *not available*). At this site, such perforators were fairly well made with the surfaces scraped with a chipped stone tool to further smooth the surface. The rib was first either entirely or partially split. One specimen with a high handling polish has a rippled tip, suggesting intensive contact with hide or leather. Another has a honey brown color suggesting it was also intensively used before being broken. Rib perforators were distinguished from broken double rib perforators on the basis of whether there was evidence of handling wear on the base and the kind of use wear at the tip. Normally, double rib perforators do not exhibit strong use polish at the tip.

8. *Double point* made from long bone (*Schibler type 2/1, Makkay type IX*). *N* = *2. Class I (Figs 29.8a–b and 29.9a–b)*: (*GL* = *74.8–87.4 mm, GB* = *6.6–8.3 mm, GD* = *4.3–6.0 mm, Btip* = *3.0–3.2 mm*). Such very well-made and intensively utilized tools are found sporadically on both Neolithic and Bronze Age sites in the region (Choyke 1984; 1998; Perišić 1984, plate 7; Makkay 1990a, fig. 9. 1–21; Russell 1990). Typically, they have been called fishing gorges based on ethnographic parallels (Herman 1883, 1885), but the specimens from this site are quite robust with an ovoid rather than flat cross-section. They appear to have been hafted based on differences in color and texture between the two halves. The advantage to hafting perforators as opposed to using bone perforators on their own is that the grasp is improved if the haft is made of nice smooth wood or bast. Thus, it is clear that these carefully cut, ground and finished tools would have been used in work requiring greater precision. They also seem to have better preserved surfaces than most of the other tool types, especially the double pointed rib tool. Both display some degree of curation which suggests they were probably not used as projectile points. Bone projectile points usually appear in settlement assemblages either in a new form or broken during manufacture. They were often discarded or lost off-site. It is quite possible that these objects may have been used as pin-beaters for weaving on a vertical warp-weighted loom. Such a function would be consistent with both their size and macro-wear in the form of an expressed surface polish from the tip to mid-shaft. These two specimens were formed by scraping a longitudinal

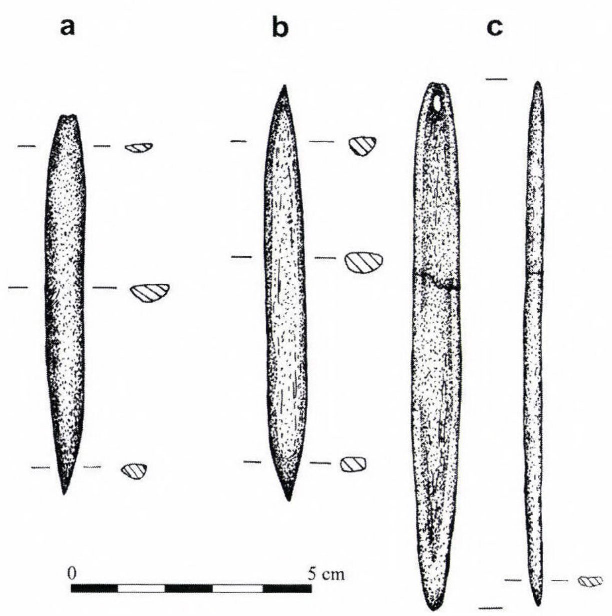


Fig. 29.8. More elaborated class I pointed tools: a. cattle-sized metapodium based double point (Schibler 2/1); b. cattle-sized metapodium based double point (Schibler 2/1); c. two views of cattle-sized metapodium based 'netting' needle

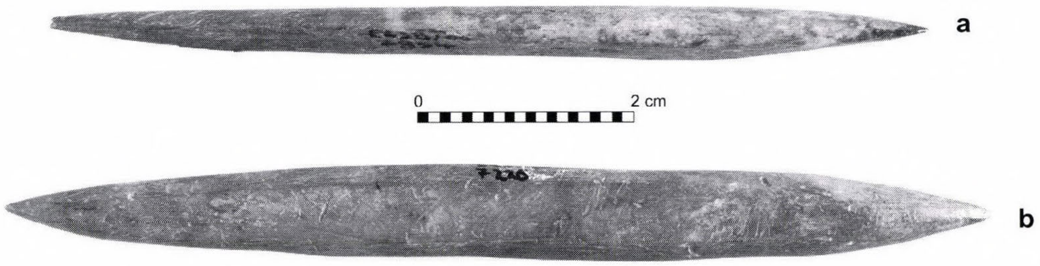


Fig. 29.9. Photograph of two cattle-sized metapodium based double points: a. metapodium based double point; the two halves of the tool are coloured differently suggesting hafting (Schibler 2/2); b. more massive metapodium based double point; the two halves of the tool are worn differently suggesting hafting (Schibler 2/2)

diaphysis fragments with chipped stone tools, followed by intensive abrasion. Abrasion was also used to roughen the portion of the tool fitted into the haft. In this sense, they are also unusual given that marks of abrasion are often not visible on the tools from this site.

9. *Double point* made from rib (*Schibler type 2/2, Makkay type XIX*). *N =15. Class I (Figs 29.10b–11): (GL = 77.0–134.2 mm, GB = 4.6–13.4 mm, GD = 2.6–4.4 mm, Btip = 1.1–1.7 mm*). This fragile tool type is one of the most common at this site as well as elsewhere in the region. Makkay (1990a) reports that that it comprises 18% of the total bone types found at his excavations. After splitting, the Ecsegfalva 23 rib tools were largely abraded to shape. There is only one double rib perforator which was certainly not hafted and is exceptionally well made. The relative fragility of this type and the fact that generally the surface of these tools is not well preserved would seem to preclude these double points being used to make holes in leather. They were probably used in a range of activities and had a short working life. The weak point of such tools seems to have been in the middle which must be related to the way these tools were used. This vulnerability to stress required that it must have been necessary to continually manufacture new double perforators. Such a

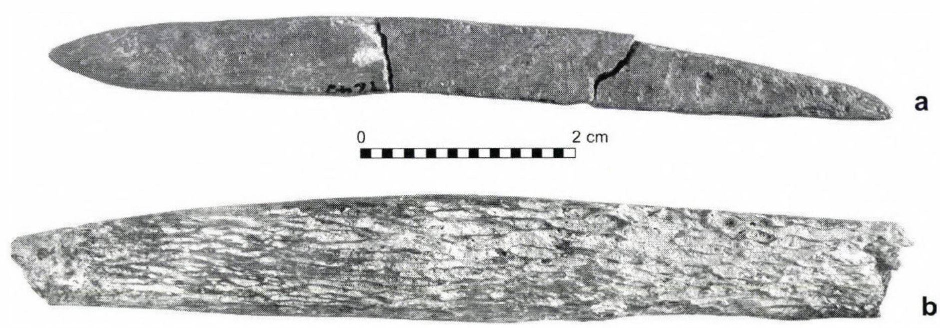


Fig. 29.10. Two rib double points from caprine rib (Schibler 2/2): a. small rib double point; b. large rib double point from site 16

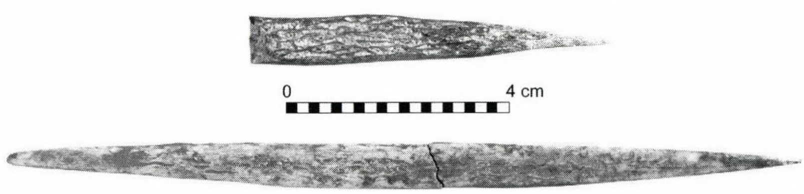


Fig. 29.11. Two small rib double points (Schibler 2/2), one complete and the other broken in half and discarded without re-working

Fig. 29.12. Possible flat projectile point. The difference in colour between the two halves suggests it was bound to a shaft (Schibler 2/3)

Fig. 29.13. Massive bevel-ended tool with epiphysis (Schibler 4/8) from cattle metatarsus. The working edge is damaged

tool might well have been used as a fishing gorge but in the absence of marks of attachment this hypothesis must be delegated to the realm of speculation. Double perforators were most often made from split caprine ribs. Their tips were ground to points, the long edges flattened and the spongiosa ground flat using some kind of abrasive stone materials. Some of these double points were probably reworked after breaking into simple perforators, used in different ways. One double rib perforator was found at the neighboring site of Ecsegfalva 16.

10. *Projectile point (varia)* (*Schibler type 3/2, no Makkay type*). *N = 1. Class I (Fig. 29.12):* (*GL = 74.8 mm, GB = 6.6 mm, GD = 4.3 mm, Ltip = 28.7 mm, Btip = 2.3 mm*). This tool is described here as a bone projectile point based on the fact that the manufacturing striations show no rounding of their edges from handling or use wear, suggesting that this object is new. The point was nicely finished with grinding that obscures other manufacturing marks. This is the only example at this site and indeed, bone projectile points do not appear common anywhere in the Starčevo-Körös-Criş cultural complex.

11. *Massive bevel-ended tool with epiphysis* (*Schibler type 4/3, no Makkay type*). *N = 2. Class I–II (Fig. 29.13):* (*GL = not available, GB = 40.9 mm, GD = 16.9 mm, Bedge = not available*). Both objects are made from cattle metatarsal bones. They were grooved with a chipped stone down the median line along the cortical bone and through the proximal epiphysis. The distal diaphysis was removed totally, and the distal end of the remaining diaphysis ground to form a long beveled edge. The surface of both tools is poorly preserved and the working edges broken-off. Such tools could have been used for removing bark from trees or even processing wood, e.g. as wedges for splitting logs, all of which would explain why these massive objects are so damaged.

12. *Large ad hoc bevel-ended tool* (*Schibler type 4/7, no Makkay type*). *N = 2. Class II* (*GL = 47.8 mm, GB = 22.9 mm, GD = 6.0 mm, Bedge = 16.3 mm*). These two pieces fit the overall look of the assemblage as Class II tools displaying little manufacturing wear and only moderately used. One is based on a processus spinosus of a thoracic vertebra from a red-deer size animal. The other is made from flat bone of some kind of large ungulate. None of these two tools show signs of curation.

13. *Small ad hoc bevel-ended tool* (*Schibler type 4/8, no Makkay type*). *N = 2. Class II* (*no measurements available*). Both specimens are *based on broken Class I tools* which were re-used with very limited modification. One such tool was based on a metapodium diaphysis from a cattle-size animal, which had been a type 2/1 double point, while the other was re-worked from some kind of large pointed tool. Their surfaces are poorly preserved, suggesting that they were used but then disposed of so they lay around on the ground surface.

14. *Small double bevel-ended tool* (*Schibler type 4/9, no Makkay type*). *N = 1. Class I (Fig. 29.2c):* (*GL = 75.0 mm, GB = 7.1 mm, GD = 2.8 mm, Bedge = 4.4 mm*). This tool seems to have been carefully reworked from a 2/2 rib double point. The caprine rib was split and its edges scraped smooth and the substantia spongiosa flattened with scraping. The manufacturing striations are well rounded suggesting relatively intensive use.

15. *Bevel-ended tools made from rib* (*Schibler type 4/10, no Makkay type*). *N = 7. Class I–II (Figs 29.14–15):* (*no measurements available*). The fragmented ribs of cattle-size (in one case aurochs-size) animals, were not split except at the distal end where an edge was formed with moderate grinding. The substantia spongiosa was left unmodified by either scraping or grinding. The bevel appears on only one surface. Perhaps such tools were used

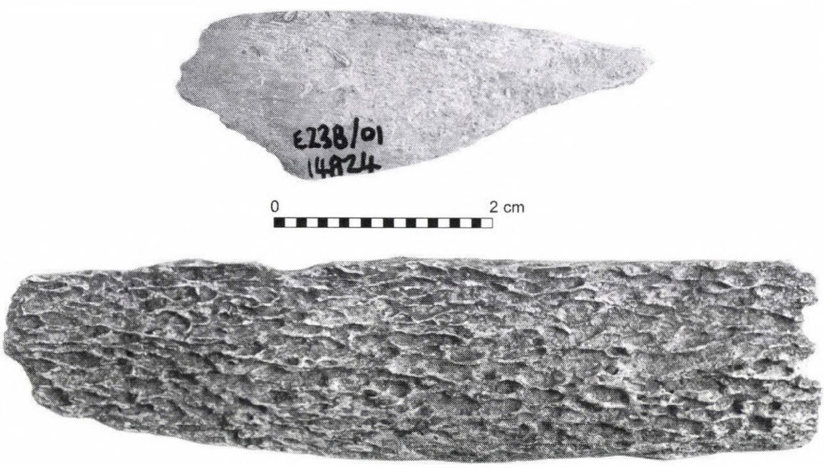


Fig. 29.14. Cattle-sized rib based bevel-ended tool fragments (Schibler 4/10)

in cleaning skins or scraping ceramic surfaces. Given the natural form of large ruminant ribs, these tools are very common at prehistoric sites in the Carpathian Basin. In fact, they are index tools for the Transdanubian Middle Bronze Age Vatya culture (Choyke 1984) although those later tools often exhibit intensive wear in the form of high polish compared to the specimens from Ecsegfalva 23 which were neither intensively used nor curated.

Fig. 29.15. Cattle-sized rib based bevel-ended tool fragment (Schibler 4/10)

16. *Spatula (Schibler type 12, no Makkay type). N = 2. Class I.* Only two small fragments of cattle rib-based spatulae are present in this material. The rib was split and the edges and substantia spongiosa ground flat. However, only small fragments were recovered. The surface is badly damaged but it is still possible to see that this was clearly a planned, Class I type tool. Spatulae were to become a very important tool type later on in the Neolithic period in the Carpathian Basin (for example Russell 1990).

17. *Rectilinear scraper from wild swine tusk (Schibler type 17, Makkay type XXXV). N = 1. Class I (Figs 29.16–17): (no measurements available).* This tool type has an elegant S-shape in its most common form throughout most of the prehistoric period in the Carpathian Basin. However, it appears that in both the Iron Gates Mesolithic as well as the Early Neolithic such scrapers have a more rectilinear form with both blunt and pointed ends (Bačkalov 1979, Plates VII. 7, XI. 6, XIV. 20–23, XVIII. 2–9, XXXVII. 10; Makkay 1990a, figs 17. 1–4, 18. 4) was made from the split lower tusk of wild and large domestic male pigs. The inner surface was scraped with a chipped stone blade and the edge modified with scraping to strengthen it by increasing the angle. The single beveled edge and point was continuously renewed. It has been suggested that such tools were used in wood working as scrapers (Sidéra 1991, 14). These tools appear in the Early Neolithic of the Carpathian Basin and well beyond. They as appear in moderate numbers until the end of the Bronze Age.

Fig. 29.16. Photograph of rectilinear tusk scraper fragment from split wild boar tusk (Schibler 17)

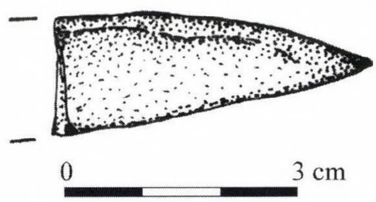


Fig. 29.17. Drawing of same rectilinear tusk scraper fragment from split wild boar tusk (Schibler 17)

18. *Large 'netting' needle-like tool (Schibler type 21/1, no Makkay type). N = 1. (Fig. 29.8c): (GL = 119.9 mm, GB = 11.1 mm, GD = 4.5 mm, Ltip = 60.8 mm, Btip = 4.0 mm, Dhole = 2.4).* Made from a longitudinal fragment of a cattle metapodium this large needle was discarded when still unbroken and eminently usable. The closest parallel comes from the Criş site of Trestiana although that needle is thinner and round in x-section (Beldiman and Popuşoi 2001, fig. 4). This needle was abraded to a symmetrical, flattened shape like an elongated willow-leaf. The long hole was scratched out with a flint tool. The tool was well worn, with a rich honey brown colour. It was discarded while still unbroken and useful suggesting that it was deliberately left behind. It would have been used in activities such as weaving nets or textile production unlike the much finer needle reported on by Makkay (type X, 1990a, fig. 9. 1).

19. *Bone spoon with elongated bowl ending in a V-shape (no Schibler, Makkay type 'Löffel'). N = 2. (Figs 29.7b and 18): (GL = 101.8 mm, GB = 24.0 mm, GD = 7.8 mm, GLength of bowl = 46.7 mm, GB of bowl = 24.0 mm, GL of handle = 53.4 mm, GB handle = 10.0 mm, Btip handle = 3.0–14.2 mm).* The spoons of the Starčevo-Körös-Criş cultural sphere are perhaps among the best known. They are found on almost all sites of these cultures over a broad region, and are the bone tools most likely to be reported on in archaeological site reports for this period (Nandris 1972; Bačkalov 1979, plates XXIV9. 13, XXV. 8–10;

Makkay 1990a, 24–28; Popuşoi and Beldiman 1993–1998, 148; Beldiman 1999–2000, figs 6–8). It was John Nandris who first suggested that these special and indubitably beautiful objects were made exclusively from the metatarsus of wild cattle. Today we know that spoons can be made from the metatarsus of both wild and domestic cattle. The complete spoon from Ecsegfalva, found near the grave pit in 23C, was made from domestic cattle or small aurochs bone while the broken handle end could well have been carved from the distal metatarsus of a large wild cattle. Nandris' scheme for spoon manufacture (1972, 81–83) has been broadly accepted. Spoons were always curated and as a result they come in many different shapes (see Makkay 1990a), although the V-shape of the spoon bowl is always preserved, probably deliberately. The closest parallel to the Ecsegfalva 23 spoon came from Endrőd 119. Some of these spoons have the ridge on the backside of the bowl as well. There are some spatulate spoons made from large ribs. Sometimes the bowls of the spoons were curated down to small points. The distal epiphysis which was often retained in a very modified form marked a weak point of the handle which often broke at this point. The handle was then shaped into a point. The final form of the spoons and all the re-working was carried out using abrasion. These objects must have lasted for the lifetimes of the people in the household they were used in. Furthermore it may be important that in addition to their special shape, almost like a small abstracted human head with a chin, they were made uniquely from wild or domestic cattle bone. It is also curious that these beautiful, intensively used and curated objects, were often discarded while still useful. Spoons also particularly stand out because they are often glossy with handling polish and the polish coming with scraping with chipped stone. They were continuously re-modeled and re-used and may have been used throughout an individual's lifetime. Again, if it is assumed that the settlements were only occupied for a few years, people must have carried the spoons with themselves from location to location. These spoons are often discarded in an unbroken state when they could still be used. Their consistent presence on archaeological sites of the period in the region suggests an importance hard to comprehend today. Clarification of this issue may lie in pinpointing the exact kind of location within sites they tend to be found in.

20. *Massive hook (no Schibler, Makkay type XXIII). N = 2 (1 piece broken in two). (Figs 29.7c and 19): (GB = 17.2 mm, GD = 9.2 mm, Inner diameter = 38.9 mm).* Massive 'hooks' are identified on the basis of shape. They are also consistently represented in the archaeological literature on sites of the Starčevo-Körös-Criş cultural sphere (Kisléghi Nagy 1911; Bačkalov 1979, plate XVII. 8–11; Makkay 1990a, 40–41, 45; Beldiman 2000, figs 5–7).

Fig. 29.18. Spoons with V-shaped base: a. re-worked but complete spoon from cattle or small aurochs metatarsus; b. the remains of a spoon handle from the broken-off modified distal epiphysis of an aurochs metatarsus

Similarly to the aforementioned spoons, these objects are always polished and glossy from handling polish, but unlike spoons they are not reworked. In fact, they are always found broken on sites, in particular the tip with the indentation next to it – exactly like the specimen from Ecsegfalva 23. These objects must have been part of individual adornment and were discarded either when they broke or, possibly, they were broken deliberately and one part (the tip) remained in the settlement after its abandonment. The tip of the Ecsegfalva 23 specimen was broken off and found somewhat separated from the rest of the hook. In the Körös region these hooks appear to be manufactured exclusively from the long bone diaphyses of wild cattle, particularly the humerus. Debris from this manufacturing process was found at nearby coeval sites such as Endrőd 39 and 119 and Szarvas 23 (Makkay 1990a, figs 13. 13–18, 14. 10). Here again we find a special object being made exclusively from cattle bone. If it is true that cattle, and particularly wild cattle, were animals with significance beyond simple economic use, then the raw material would have enhanced the special symbolic meanings behind these hooks. The diaphyses were sawn across, usually above the distal end where the cortical bone is thickest. The Ecsegfalva 23 specimen is so well worn that further marks of manufacture are obscured but the general appearance suggests that the final stage of manufacture must have included deliberate, intensive polishing of the cortical and medullary surfaces. Furthermore, there is an even more elaborate variety of these hooks found in the Iron Gates region and elsewhere in the Criş area made from the rose of red deer antler (Beldiman 2000). Red deer was not a game particularly exploited in the Körös region. Antler was not used at all at Ecsegfalva 23. It is possible that these hooks also were meant to recall these special kinds of antler burr based hooks with the concept of 'wild' combined with the use of aurochs bone as a raw material.

Fig. 29.19. Fragmented massive hook from an aurochs size long bone diaphysis

21. *Ring plugs – debris type 1* (*no Schibler, no Makkay type*). *N = 7. (Figs 29.20b–c, 21, 22b–d): (GB = 14.7–19.2 mm, GD = 7.1–8.8 mm*). These 'plugs' possibly represent debris from one particular type of ring-making. They have not been found elsewhere on coeval sites, mainly because they are small and thus, unlikely to be found where finer excavation techniques are not employed. All the plugs come from the upper occupation levels. In particular, three of the seven plugs were found in the upper occupations of the northern extension area together with the large needle and massive hook fragment. The fact that these three plugs were found together in the same excavation unit (454) suggests that there may have been a small workshop area for

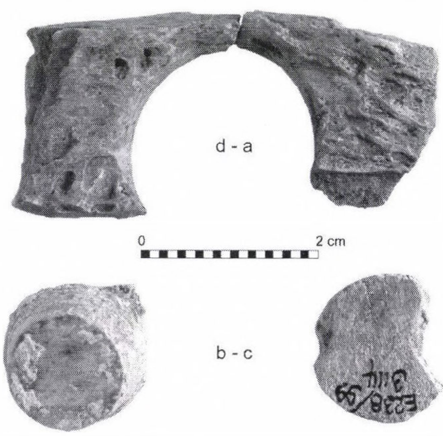


Fig. 29.20. Long bone cut-outs (ring-making type 2 debris) and 'plugs (ring-making type 1 debris): a. and d. ring cut-outs from cattle size long bone diaphyses (ring-making type 2 debris); b. and c. 'plug' (ring-making type 1 debris) probably from aurochs long bone diaphyses

ring-making nearby. Probably only larger cattle and wild cattle long bone diaphyses near the distal epiphysis would have had sufficiently thick cortical bone to produce rings. The hypothesized manufacturing stages include drilling out a bone core with a diameter equivalent to the outside diameter of the intended ring *(Fig. 29.21)*. The plugs come from drilling out the inside of the ring from one side. The grooving from attempts to get the drilling started can be traced on the surfaces of some of these plugs *(Fig. 29.22)*. The tradition of ring-making was probably brought from Anatolia. Russell (2001) reports evidence of the use of bone rings from Çatal Hüyük some 2000 years earlier. This manufacturing technique however, has not been reported on elsewhere.

Fig. 29.21. Close-up of 'plug' (ring-making type 1 debris) from aurochs long bone diaphysis

22. *Ring-making debris type 2 – the outer circle* (*no Schibler, Makkay type 'individual'*). *N = 2. (Figs 29.20 and 22a):* (*Gdiameter = 19.0–19.8 mm, GD = 5.2–6.6 mm*). These two pieces of ring making debris represent the hypothesized first stage in one type of ring manufacture when a core is produced. Both these two pieces were probably taken from the long bone diaphysis of a cattle-sized animal, although the bone itself is not as thick as would be expected from the greatest depth of the plugs which were found at this site. Makkay reports a find of a similar 'cut-out' from Endrőd 119 (Makkay 1990a, fig. 16. 5).

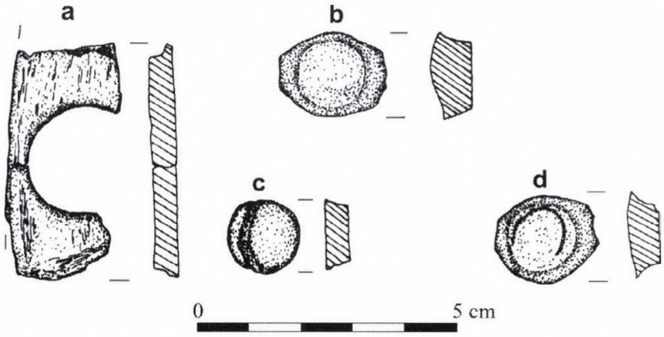


Fig. 29.22. Drawing of ring-making types 1 and 2 debris: a. cut-out type 2 ring-making debris; b. 'plug' type 1 ring-making debris

23. *Ring-making debris type 3* (*no Schibler, no Makkay type*). *N = 1. (Figs 29.23a–24):* (*Gdiameter of cut = 18.6 mm, GD of cortical bone at cut = 3.0 mm*). This is a caprine femur dia-physis fragment cut across, representing a different mode of ring manufacture. The craftsperson took advantage of the tubular shape of such long bones. The ring produced has similar dimensions to those manufactured by the aforementioned method. At this point it is unclear why two different methods of ring production would have been used since raw material from both domestic cattle and caprines would have been equally available. Again the question arises, however, as to whether rings produced from wild cattle long bones would have had a different, special meaning. No other similar pieces of debris have been reported from other contemporary sites in the region or even beyond.

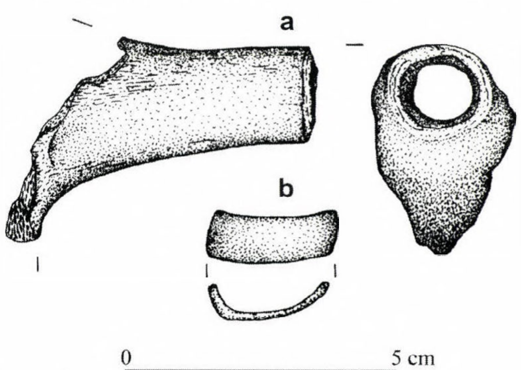


Fig. 29.23. Type 3 ring-making debris based on sections of caprine long bone diaphyses and finished ring fragment

24. *Fine ring* (*no Schibler, no Makkay type*). *N = 1. (Fig. 29.23b):* (*Outer Gdiameter of ring = 23.8 mm, GD of cortical bone = 2.5 mm*). This finely polished ring fragment has no known

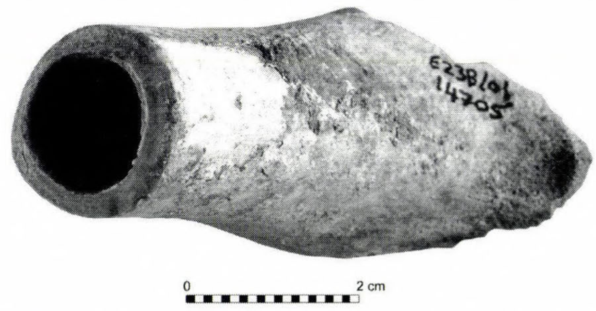


Fig. 29.24. Close-up of sawn caprine femur diaphysis from type 3 ring-making debris

coeval parallels in Hungary, although this may be related to the small size and relative fragility of this artifact type. It is, however, similar to rings found at Çatal Hüyük both in terms of form and manufacturing technique (Russell 2001). Bačkalov (1979, 49) says that bone rings are common throughout the Neolithic of Serbia. After a ring of bone was cut from the diaphysis of a caprine long bone, its surfaces were evened out and ground away to produce this fine piece. The Ecsegfalva 23 ring is highly polished as a result of such finishing work and handling.

25. *Handle* (*no Schibler, no Makkay type*). *N = 1 (no measurements available).* This fragment of a handle was made from the diaphysis of a caprine metacarpus. There are no contemporary parallels from the region. One end was sawn and the cut displays rounded edges from use. The other end is not available since the handle broke in half and one end is missing.

26. *Wavy-edged ribs* (*no Schibler, no Makkay type*). *N = 2. (Fig. 29.25a–b):* (*GL = 129.03 mm, GB = 25.0–38.3 mm, GD = 4.7–8.1 mm, Distance between peaks = 23.2–25.2 mm*). These two crudely made tools are made from one cattle rib and one aurochs rib. They were split, but the spongiosa remained unmodified. One edge was carved with a chipped stone tool to form a wavy line with a beveled edge, reminiscent of the edge of tusk tools. The cortical surface of both tools is glossy from handling and the end is ground and rounded on one of them. The working edge of this same tool is worn with a glossy, rippled surface suggesting some use on hide or leather. This tool has no parallel at other contemporary sites. However, since they are crudely made, they may not have been recognized in the archaeozoological assemblage.

27. *Humerus debris* (*no Schibler, Makkay type XXIII 'Rohmaterial zum Typ'*): *(Fig. 29.26).* This domestic cattle humerus fragment may be debris from the production of the aforementioned massive hooks. As opposed to other tools, the cut around the circumference of the diaphysis of the humerus seems to have been made using a cord, perhaps together with some gritty material. The cortical bone was not cut through completely and a ridge of broken bone remains. The surface of the cut is smooth with none of the striations typical of sawing with a flint tool. Makkay (1990a, figs 13. 13–18, 14. 1–10) reports on a number of pieces of similar raw material, although most were more cleanly worked. Many of these pieces come from both wild and domestic cattle humerus and tibia (Makkay 1990a, 43) and, as opposed to the Ecsegfalva 23 specimen, may also originate from aurochs. A similar specimen was also found in the Early Neolithic levels from Schela Cladovei in the Iron Gates, with marks of the same kind of cord cutting.

Fig. 29.25. Wavy-edged tool type: a. cattle rib with one end ground smooth, the surface of the beveled edge is rippled from contact with soft material like leather; b. possible as aurochs rib lacking ground ends, beveled edge renewed with chipped stone tool shortly before being discarded

28. *Blank.* This cattle metatarsus, with the distal epiphysis retained, was split down the med-ian line with the groove carved completely through the cortical bone and epiphysis using a chipped stone tool. It is otherwise unworked, but could have been further modified to produce e. g. a massive bevel-ended tool (Schibler type 4/3).

Fig. 29.26. Large cattle humerus with cord cut diaphysis, possibly from massive hook manufacture

29. *Bone with manufacturing striations.* All three pieces of bone come from cattle-sized animals and were probably splinters of metapodia. All three had patterns of deep cut marks made with stone chipped blades. These cuts are more characteristic of bone manufacturing than skinning. It is not clear whether these fragments are parts of broken tools or manufacturing debris.

Species and skeletal element distributions

The species contributing the most bone to the production of tools and ornaments are sheep and possibly goat *(Fig. 29.27)*. The prominence of sheep as providers of bone is related to simple availability since caprine bones represent 82% of the total NISP (Bartosiewicz, this volume). Metapodial awls (Schibler types 1/1 and 1/1 varia), on which the distal epiphysis was retained, can be identified more specifically as coming from sheep as opposed to goat. Caprine ribs *(Fig. 29.28)* were deliberately selected to produce double pointed rib tools (Schibler type 2/2). Otherwise much of the caprine long bone material appears to be non-selected, used on a more *ad hoc* basis. In some sense, caprine bone could be said to be under-represented in the tool assemblage although it is very likely that the small non-identifiable species category is most probably composed of small fragments of caprine bones.

Identification of cattle and aurochs were largely based on size, that is, the relative thickness of the cortical wall of the bone from which the tool was made. The ribs and long bones of wild and domesticated cattle were used to make some of the more elaborate, special objects, including the large needle, the wavy-edged tools, the large double points from long bones, the spoon, the massive hook as well as ring-making debris found in the form of plugs. All these are represent less common but more elaborate Class I tools. Many of these tools were discarded unbroken when they were still useable. Here the raw material was clearly selected in the first part of a multi-stage manufacturing and curation process. Cattle has been ritually treated as a special animal since the very beginning of the Neolithic. This is shown, for example, by the well-known wall-paintings and bucrania at Çatal Hüyük (Mellaart 1963, 63; 1964, 48, 63). This tradition continues into the later Neolithic as figurines and small ceramic horns of consecration (Gimbutas 1982, 91–92). While we have no specific evidence of the ritual treatment of cattle in the Körös culture, Nerissa Russell's argument that Neolithic cattle would have been valued as a way of accumulating wealth might mean that special significance was also attached to raw materials which were derived from this animal.

One very interesting taxonomic aspect of tool manufacturing at Ecsegfalva 23 was the virtual absence of red deer. Two *ad hoc* tools were produced from vertebral spines of this species. However, astonishingly, there are no tools made from antler. Antler can be gathered and we know that deer must have been present in the environs of the site since their bones sporadically occur in the assemblage of mammalian remains (Bartosiewicz, chapter 14). Although antler is usually a well-represented raw material in prehistoric tool assemblages in the Carpathian Basin, it seems to have been less often used on Early Neolithic sites in the Carpathian Basin. Makkay (1990a, 49) reports on a total of 33 worked pieces of antler out of a sample of 600 tools, corresponding to a mere 5.2%. Those objects seem to be mostly tines with worked tips (Makkay types XXXVIII

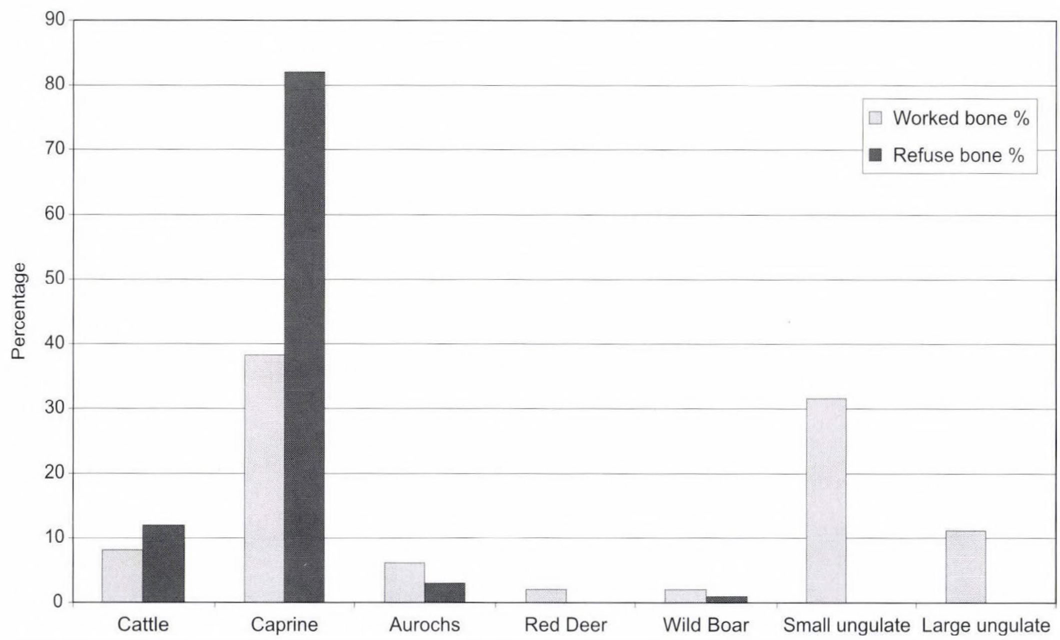


Fig. 29.27. Taxonomic comparison between the refuse and worked bone assemblages

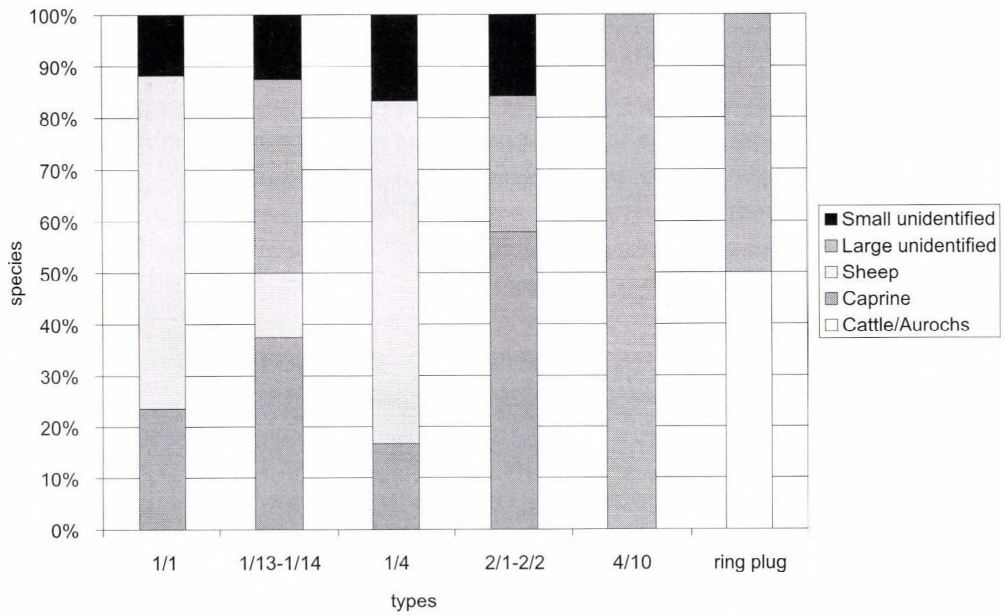


Fig. 29.28. Species selected for different types of bone tools

and XXXIX). However, red deer was important in the ritual life of these people as suggested by a half antler rack found in a pit at Szarvas 23 (Makkay 1990a, 23). The rack was placed at the bottom of the pit. It is reported that two small jugs hung from the tines together with two rib spoons and 22 obsidian tools. It was covered by a layer of ash.

Finally, the two pig tusk tools from Ecsegfalva 23 were most likely from wild boar based on their sizes. It is likely that tusk was always used for tool or ornament production when available.

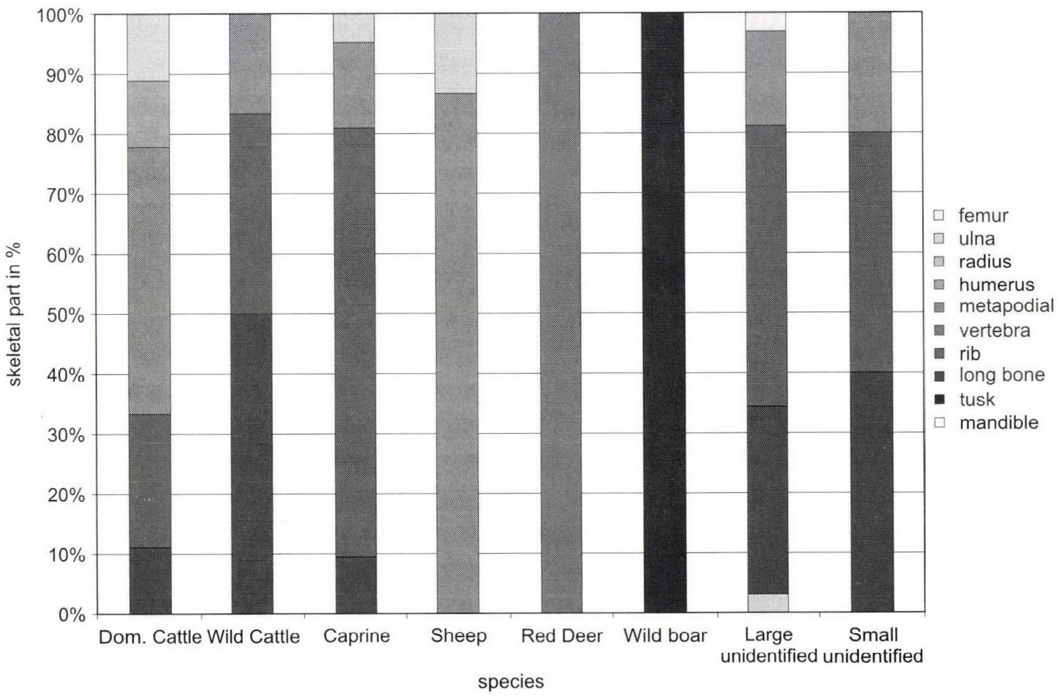


Fig. 29.29. Skeletal elements used from different species (n = 98)

The two most important skeletal elements used at Ecsegfalva 23 in tool manufacturing were long bones, particularly metapodia and ribs *(Fig. 29.29)*. This seems to be consistent with what was found in the Körös assemblages reported on by Makkay. The use of cattle humeri in the production of massive hooks seems to be a unique feature at these Early Neolithic sites on the Great Hungarian Plain with no evidence that these hooks were ever made from red deer antler burr as reported on Criş sites (Beldiman 2000).

Degrees of Completion

The condition of the tools was studied as well using the following categories:

1. used and broken
2. used and unbroken
3. new or barely used
4. unfinished object
5. unfinished due to failure of raw material
6. shaped raw material and
7. debris

The majority of the tools, 51%, were used and broken when they were discarded while 35.7% of the tools were still useable when then they were abandoned. The 11 pieces of debris from various kinds of readily identifiable ring manufacture represent 11.2% of the sample. There was one half finished piece and one piece of shaped raw material.

When the condition of the used tools is broken down by type and fragmentation, it is clear that several factors must have played a role in when the objects were thrown away *(Table 29.3)*.

Around half of the 1/1 metapodial perforators were thrown away when they broke. However, a number seem to have been discarded when they were uniformly curated down to 'pencil-stub' and would have become too short to use comfortably. The tips of these objects were often perfectly intact and freshly reworked. However, the end of their working life was close so they may have been left behind when the settlement was abandoned. The less well-made perforators (1/4, 1/13, 1/14) were less intensively curated and more likely to thrown away broken.

The three long bone based double points were all used but unbroken when deposited in the site. They all show signs of having been curated and used. They may simply have been lost or deliberately abandoned. The situation with the smaller, more fragile rib-based double points is different. The majority of these tools were found broken, usually in half. This thin, fine bone tool type was more likely to break. Apparently, they were only re-ground if the tip broke.

Bevel-ended tools made from ribs, with one exception, were used and unbroken when they were thrown away. These tools are not modified to any great extent but it would have been easy to renew the edge. None of these tools displayed the high polish characteristic of intensive use. They may have been used in an *ad hoc* manner and simply discarded when a set of tasks came to an end.

Of the special tools, the ring and the massive hook are decorative objects that cannot be repaired when they break. The metapodial pin with a ground flat base on the other hand, was continually reworked as it broke but was relatively quickly deemed to be unusable at 69.7 mm. It is 30 mm longer than the biggest of the 1/1 metapodial perforators discussed above. The point is intact. It seems likely that it functioned differently from the 1/1 perforators, perhaps as a clothing pin.

The end of the spoon handle, normally comprised part of the modified distal epiphysis, shows the point where new spoons seem to have been weakest. The end fragment may be

Table 29.3. Frequencies and percentages of species used to make bone tools and percentages of the main species in the refuse bone assemblage

Species	Number of tools	% of tools	% of refuse bone
Cattle	8	8.16	12%
Caprine	38	38.97	82%
Aurochs	6	6.12	3%
Red Deer	2	2.05	-
Wild Boar	2	2.05	1%
Small non-identifiable	31	31.63	-
Large non-identifiable	11	11.22	-
Total	**98**	**100**	

regarded as a kind of debris. The complete spoon found at Escegfalva 23 was glossy from use and continuous re-working. It could still have been used as could the large needle which actually appeared newer and less worn. Makkay (1990a) reported a total of 7 new and 30 spoons from his excavations which had been re-worked to various degrees and into various forms. The fact is that these spoons are often found used but complete. Fragments represent small broken off pieces which can be repaired on the spoon itself. As has been previously suggested, such tools may finally have been abandoned only when the owner(s) died.

Table 29.4. Condition of tools

Schibler type	Used and broken	Used and unbroken
1/1	8	7
1/4	4	2
1/13	2	1
1/14	3	2
2/1		3
2/2	12	4
4/10	1	7
4/3, 4/7–9	3	3
1/1 varia		1
Spoon	1	1
Hook	1	
Ring	1	
Needle		1
Wavy-edged		2

The wavy-edged tools were not very carefully made although the edge was renewed as it chipped. Both specimens from Ecsegfalva 23 had worn, eroded surfaces suggesting that they were not immediately buried after disposal. They appear to be complete but it may be that like the 1/1 perforators, curation work had reduced them to an inconvenient size.

Manufacturing techniques

There are only a small number of tools where the manufacturing sequence is absolutely clear. The various kinds of ring manufacturing have been discussed in the type descriptions. Modes of manufacture for the 1/1 perforators and the spoon have been described several times elsewhere (Nandris 1972; Campana 1989; Popuşoi and Beldiman 1993–1998; 2002).

The relative absence of tools produced with scraping and abrasion is remarkable *(Fig. 29.30)*. This is not too surprising given the general absence of stone in the environs of the site. Typically on later prehistoric sites in the Carpathian Basin chipped stone tools were used for cutting and scraping while the final form of tools was produced by grinding on a stone. Tips of perforators were also typically reworked on prehistoric sites using abrasion whereas at Ecsegfalva 23 the 1/1 perforators were reworked with chipped stone tools. As can be seen on *Fig. 29.30,* the spoon and 2/2 rib double points abrasion was consistently used in the initial shaping and reworking of these

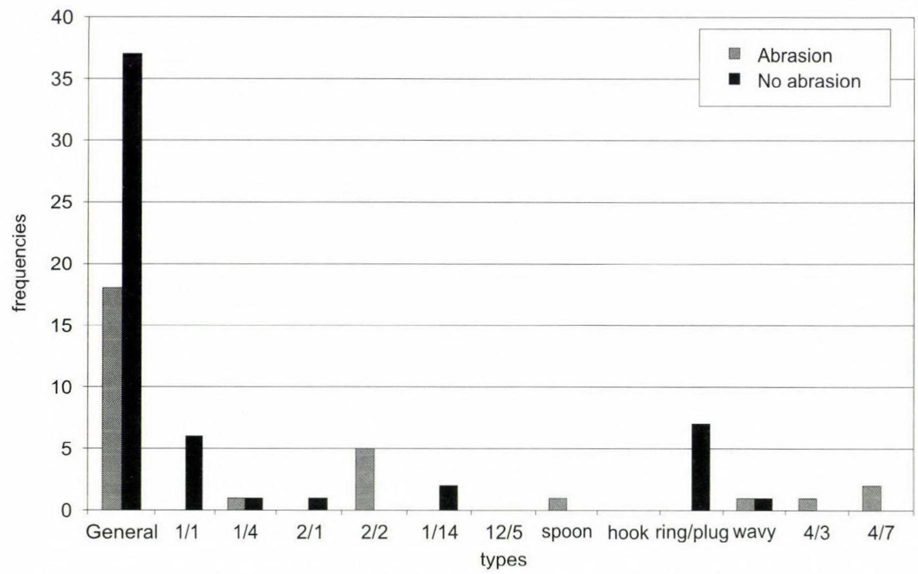


Fig. 29.30. Tool types consistently manufactured using abrasion as well as other manufacturing techniques

tools. The manufacture of the working end of bevel-ended tools (4/3, 4/7–9) also is best explained by abrasion. There are approximately twice as many tools that have only marks of scraping visible on their surfaces as opposed to the typical manufacture pattern of scraping combined with abrasion. Whether this technical style was unique to the people of this settlement and related to the scarcity of stone, or whether it marked a cultural preference characteristic of the Körös people, can only be determined after use wear in bone tool materials from a number of sites is studied.

Spatial distribution

Although there are only 98 pieces of worked bone in this assemblage, it seemed useful to look at the areas and layers from where these bones come. With the exception of the 'south-east box', most of the complete bone tools come from the upper occupational upper layers, or last occupation at the settlement. This mirrors the general situation for all the bone tools and ornaments, whether complete or not. The greatest concentrations of tools were found in the upper layers of the 'north box' and 'north extension' and the upper and lower layers of the 'southeast box'.

The upper layer of the 'northern extension' is especially rich in artifacts, including 8 out of the 15 (1/1) metapodial perforators, 6 (2/2) rib double points and 3 (4/10) rib bevel-ended tools. The large needle and massive hook also come from this area. The three 'plugs', interpreted as ring making debris, come from the same context (454) in the 'northern extension' area. Two other plugs come from the upper layers of the 'north box'.

One of the spoons, the end of a handle, comes from the upper layer in the 'north box'. The complete spoon comes from the undifferentiated layers in the northwest part of test square 14/15, below the top of the pit in Trench 23C.

The upper layers of the Trench 23B 'south-east box' contain one of the wavy-edged tools and a piece of ring debris in addition to other pieces. There are two perforator types in upper layers. The lower layers from this area are rich compared to other areas. They contained 1 perforator, 2 double points, 2 bevel-ended rib tools. These layers also contained special tools including a tusk scraper fragment, a tusk ring fragment, the finely made bone ring and a small, fine double bevel-ended tool reworked from a 2/2 double point.

Finally, the 'south-east box' marked the location of another piece of ring making debris in the upper layers. The worked cattle humerus diaphysis fragment comes from the upper layers, one of the spatula fragments comes from the lower layers while one perforator and one double point come from the lowermost layers at the site.

There is also one bone tool, a (1/13) large rib point, which came from the bank of the close-by Körös site 16.

Discussion

The bone tools from Ecsegfalva 23 are generally well made, falling into the Class I end of the manufacturing continuum. They show some signs of planning and are produced in several stages with reworking. The most elaborate of these objects, such as the spoon and massive hook, display use wear which make it clear that they would have been used for periods possibly longer than the life of individual settlements themselves. Such objects would have been closely associated with their owners, perhaps discarded when the owner died. Other carefully planned tools do not display such heavy handling and use wear. Class 1/1 metapodial awls were reworked until they were no longer comfortable to use, at which point they were thrown away. The double points made of cattle-size long bones are strong tools as is the well worn complete 'netting needle' and the fact that they were found whole is somewhat enigmatic. However, if the double points were used as pin-beaters together with the robust needle in weaving on a vertical warp-weighted loom the fact that they were not fragmented during use becomes more understandable.

The rib double points, one of the most common tool types in this assemblage, were fragile and easily broken. While often showing signs of re-working, they would not have been used for very long periods. There is only one fragment of boar tusk scrapers which appears to be more squared in form as opposed to the S-shaped scraper more common later on in the Neolithic.

Ring-making seems to have been common at this village. Astonishingly there are three kinds of manufacturing technique in evidence. In one form a bone core was carved out of the flat diaphysis wall of large cattle or aurochs long bone. A plug of bone was then drilled out of the middle. No actual rings have been found – only the debris of their production, in one case, several from the same excavation unit in the northern extension area. Rings were also made from slices of the round diaphysis of caprine long bones such as the femur. One fragment of such a beautifully polished ring was found. Finally, there is a small piece of a ring cut out of a wild boar tusk.

One tool type, unique to this site, was made from cattle or aurochs rib. These tools have wavy edges reminiscent of the thin beveled-edge of boar tusk tools. It is likely that these tools do occur elsewhere but were not recognized either in the field or during faunal analysis. The more worn of the two specimens has a rippled edge.

There were almost as many transitional (Class I–Class II) tool types which fall in the middle of the manufacturing continuum. Most of the perforators are made from more randomly selected bones which broke in a lucky way. The tips are carefully worked up to a third of the way along the length of the tools, however. The tool types such as the bevel-ended tools made on ribs are not very carefully modified but, as opposed to the perforators, they are made on selected sizes of ribs from large ruminants.

Finally, there are a few tools which were made on bones picked up and used, without much modification. There were two half-finished pieces and three bone fragments with marks of manufacture on them. Altogether, aside from a hook (one piece of debitage) and several pieces from ring manufacture, there does not seem to be much evidence for tool making at the site. The more elaborate tools would have been carried away to when the community located to a new village site and the less complex tools would not have left much identifiable debris from their manufacture since they probably derive from food remains.

Slightly less than half of the tools were curated (N = 33 or 47%) and more than half were more temporary in nature, that is, made and used at the settlement, broken and finally discarded after what may have been no more than a couple years of use or even less (N = 37 or 53%).

The majority of the tools were made from long bones and ribs. Caprines contribute the greatest number of bones although this is somewhat related to their availability as they represent 82% of the NISP in the refuse bone assemblage. More *ad hoc* tools would have a better chance of being made from sheep or goat. In fact, fewer tools are made from caprine bones than might be expected.

Generally, the tools made from bones of ungulates that were of cattle or aurochs-size, tend to be more elaborate and intensively used. Many of them were discarded when still usable. It is suggested here that if cattle represented a special form of accumulated wealth for this small society, even the objects made from their bones would also take on particular value. These special tools include: the double points made from long bones, the 'netting' needle, the spoon, hook and rings drilled from cattle and/or aurochs long bones.

Wild boar contributed only tusk to the bone tool assemblage. The tusks were split and either carved into a rectangular form or used in ring-making. In any case it is clear that the people living at this settlement would have used every piece of this valuable raw material to make objects.

Surprisingly, there is no evidence for the use of red deer antler at this settlement. Antler is an excellent raw material for tools subject to shock such as hoes and picks. The exploitation of antler does seem to be generally limited in this time period in the Carpathian Basin despite the fact that red deer must have lived in surrounding areas. Red deer antler was elsewhere ritually buried and there is a representation of a red deer with a three branched rack on a coeval ceramic vessel (Kutzián 1944).

Most of the complete bone tools come from the upper occupational layers, or last occupation at the settlement. This may be related to the fact that virgin soil was not reached everywhere on the excavation. The upper layers were therefore more completely investigated. The greatest concentration of tools are in the upper layers of the 'north box' and 'north extension' and the upper and lower layers of the 'south-east box'. The upper layer of the 'northern extension' is especially rich in artifacts including 8 out of the 15 (1/1) metapodial perforators, 6 (2/2) rib double points and 3 (4/10) rib bevel-ended tools. The large, complete 'netting' needle as well as the fragmented massive hook were also found close by. Three plugs from ring-making come from the same excavation unit (454) in the 'northern extension' area. Two other plugs come from the upper layers of the 'north box'.

One of the spoon fragments, the end of a handle, comes from the upper layers of the 'north box'. The complete spoon comes from the undifferentiated layers in the northwest part of test square 14/15 in Trench 23C, below the top of the pit.

Conclusions

Close attention was paid in this chapter to details of the typology because this assemblage, although small, was complete in the sense of full recovery. A number of small finds occur here in larger numbers than would have been expected based on what is known from other bone tool assemblages from neighboring settlements. It is hoped that future researchers studying Körös bone tool assemblages will be able to use this report as a point of comparison to clarify whether these differences represent a special local tradition or are related to taphonomic loss during excavation. Hopefully, future careful excavations will enable researchers to say something about regional distributions of tool types and manufacturing traditions as well as intra-site variability when larger areas can be uncovered.

Chapter 30

POLISHED, GROUND AND OTHER STONE ARTEFACTS

Elisabetta Starnini, György Szakmány and *Alasdair Whittle*

Polished stone tools

Elisabetta Starnini

There are only 11 polished implements from the excavations of 1999–2001 *(Table 30.1)*. Most of them are fragments (eight pieces) and only three are complete tools. These last are one small axe/adze blade and two medium-size axe and adze blades *(Fig. 30.1)*. They are all very finely polished all over their surfaces, with a slightly arched cutting edge and a rounded butt. The cross-section is plano-convex or biconvex.

Despite the small number of artefacts, some considerations are possible. First of all, from the typological point of view, the implements from Ecsegfalva are quite similar to those found in most of the Early Neolithic sites of the Körös culture in the Alföld (Starnini 1994a; 1995–96; Starnini and Szakmány 1998). Unfortunately this class of artefacts of the material culture is often left unpublished from the archaeological reports, or just briefly mentioned, so that many collections are still unknown in detail. From the technological point of view, the artefacts from Ecsegfalva were worked and re-worked/re-shaped by flaking, as demonstrated by the presence, in this assemblage, of some flakes bearing one polished side. Usually stone axes, adzes and chisels were totally polished, from the cutting edge to the butt, both in the case of large-sized and smaller tools.

Recycling of broken pieces of cutting-edged tools as hammers/pestles was also a common feature in many assemblages, and probably determined by the distance of the settlements from suitable stone resource and outcrops.

The polished stone tools from Ecsegfalva were mostly manufactured with very compact and fine-grained rocks, characterised by a conchoidal fracture and a hardness of 6–6.5 on Mohs's scale. Their colour ranges from light to dark green-grey, often with pale or darker spots. The identification of the raw material was conducted only at a macroscopic level for most of the implements, looking at the rock features with the aid of a binocular microscope. Archaeometrical analyses would be useful in the future for solving some doubts (see *Table 30.1*). However, two types seem to occur at most: dolerites and hornfels.

One sample of this latter (13122) was submitted to petrographic analyses in thin section, XRD and electron microprobe, which confirmed the determination as hornfels (see below). This type of rock is widely used in the Early Neolithic for the manufacture of polished, cutting-edged tools in the Carpathian Basin. Besides Hungary (Starnini and Szakmány 1998), its use is well documented in Serbia (Antonović 2003). Outcrops of this contact-metamorphic and semi-metamorphosed sedimentary rocks are known according to Antonović (2003, fig. 2) in the formations south of Belgrade. However, because hornfels can possibly occur in the south-eastern part of the Carpathian Basin, in contact points with banatite rocks, we will need further comparative studies to identify source areas more precisely.

Table 30.1. Polished stone implements from Ecsegfalva

	Stratigraphic unit			Description	Rock	Size in mm	*Fig.*
ECSEG 16/1999	Surface find			Complete polished stone adze blade	Hornfels?	112×41×23	*30.1. 11*
ECSEG 1999 23B	317	F6	4414	Polished stone adze fragment, reused as hammer	Dark green, fine grained rock metadolerite?	69×50×26	*30.1. 9*
ECSEG 1999 23B	300	–	3031	Cutting edge fragment of polished stone axe/adze	Pale olive green siliceous rock (hornfels?)	24×22×9	*30.1. 4*
ECSEG 2000 survey	–	C3→E	2129	Flake from polished stone tool	Siliceous rock	23×14×6	*30.1. 6*
ECSEG 2000 23B	344	G10	5820	Butt of polished stone tool	Siliceous rock	21×15×16	*30.1. 8*
ECSEG 2000 23B	354	C10	7532	Butt fragment of polished stone tool	Dolerite?	45×53×35	*30.1. 10*
ECSEG 2001 23B	423	S-end	11,138	Complete, small, polished stone axe/adze blade	Basaltic/magmatic rock. Dolerite?	51×37×16	*30.1. 2*
ECSEG 2001 23B	423	S-end	11,139	Complete, polished stone axe/adze blade	Pale greyish-green hornfels	94×50×24	*30.1. 1*
ECSEG 2001 23B	423	S-end	11,144	Fragment of polished stone axe/adze blade? Very eroded surfaces	Very pale grey, soft limestone (Triassic limestone?)	40×31×12	*30.1. 5*
ECSEG 2001 23B	445	A13	12332	Flake from polished stone tool	Limestone	45×25×9	*30.1. 7*
ECSEG 2001 23B	464	E15	13122	Polished stone axe/adze fragment, reused, with hammering traces	Very pale greyish-green siliceous rock = hornfels (sample Ecseg 23B, analysed)	34×27.5×20	*30.1. 3*

The observations made by Antonović (2003, 136) for the Neolithic assemblages from Serbia led the same author to conclude that the procurement of the raw material was possibly conducted by gathering pebbles along river beds, a model which was also suggested for Hungarian sites (Starnini 1994a).

To conclude, this small collection of polished artefacts from Ecsegfalva confirms the similarity of the material culture during the Early Neolithic over a wide geographical area, both from the typological and the raw material point of views. The impression that the polished, cutting-edged tools found in settlements of this period reflect much more domestic wood-working activity rather than woodland clearance (Starnini 1994a) is again reinforced. The few implements recorded at Ecsegfalva are in fact of small size and of heterogeneous shape.

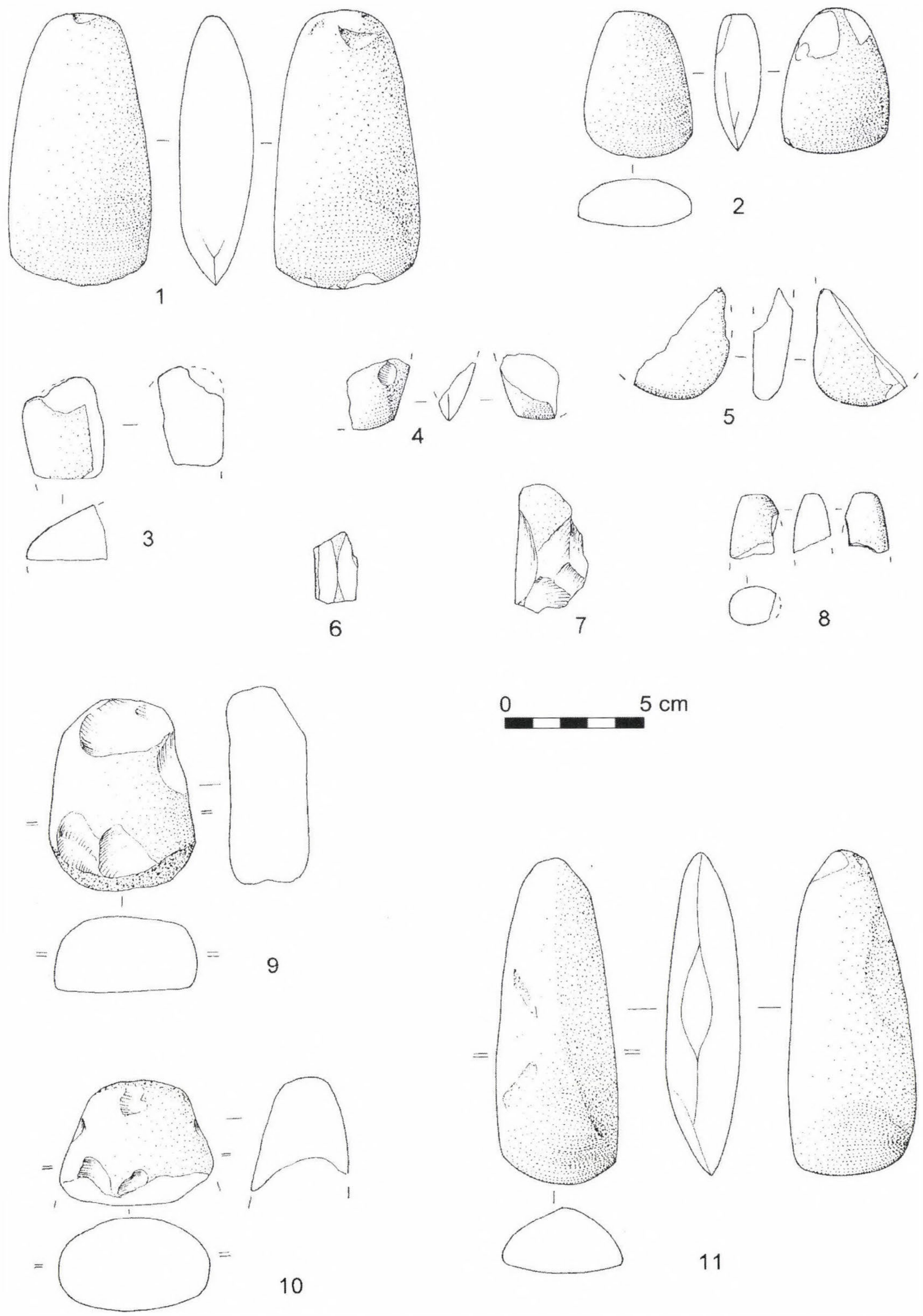


Fig. 30.1. Polished stone tools from Ecsegfalva 23 (nos 1–10) and 16 (no. 11) (drawings by E. Starnini).
1: axe/adze; 2: axe/adze; 3: axe/adze fragment; 4: fragment of cutting edge of axe/adze; 5: axe/adze fragment; 6: flake from polished tool; 7: flake from polished tool; 8: butt; 9: axe/adze fragment reused as hammer; 10: butt; 11: adze.
For contexts and materials, see text and *Table 30.1*

Archaeometrical investigations of one polished stone tool

György Szakmány

As mentioned above, one sample constituted of a polished stone axe/adze fragment, reused, with hammering traces (13122, from Trench 23B), was selected for archaeometrical investigations in order to determine the raw material.

Methods

During our work we made detailed macroscopic and microscopic descriptions and mineral composition analysis by the electron-microprobe. Microscopic description was made by Leitz Laborlux type polarising microscope. The electron-microprobe studies were made by AMRAY 1830 I/T6 SEM instrument equipped with energy dispersive X-ray spectrometer. The measurements were carried out at 15kV accelerating voltage with 2nA beam current. Natural minerals were used as standards. The results were corrected using ZAF program. The pyroxene end-members were determined by MINPROG program (Harangi 1993). The Fe^{2+} and Fe^{3+} distribution was counted according to Droop's (1987) method.

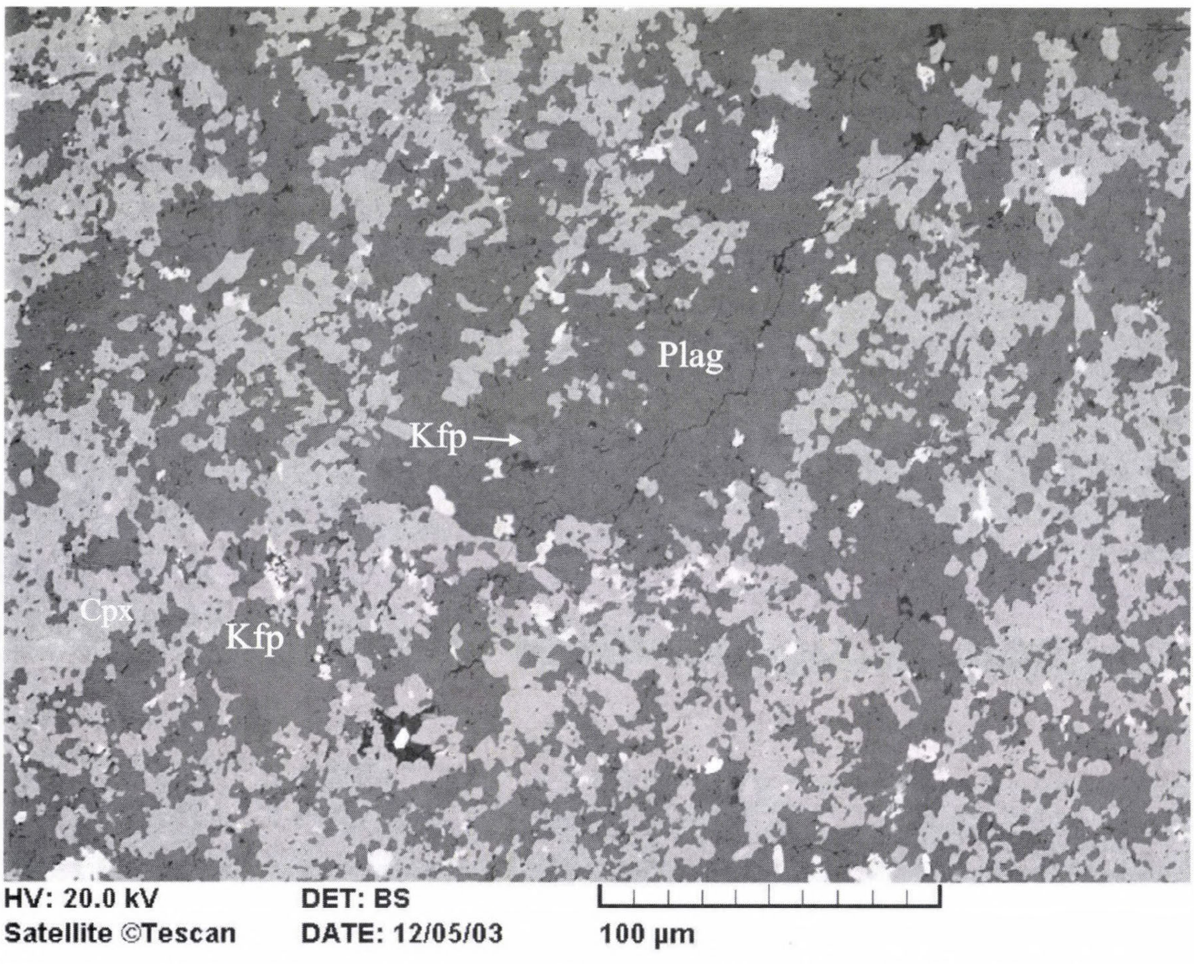


Fig. 30.2. Spotty pattern of clinopyroxene, plagioclase and K-feldspar of the Ecsegfalva 23B hornfels sample. Back scattered electron image

Macroscopic description

The sample is a very fine grained, hard and massive rock, its appearance is cloudy and it has pale whitish green-greenish white colour.

Microscopic description and mineral composition

The sample is a fine-grained (grain size is generally less than 0.1 mm), weakly banded granoblastic rock. It consists of predominantly fresh clinopyroxene and feldspars, moreover there are few and very fine grained euhedral accessories (apatite, titanite, zircon and allanite) and very small amount of secondary pyrite in it. The clinopyroxene and feldspar xenoblasts have generally closely isometric or slightly elongated shape and they contact each other along uneven lines. Both plagioclase and K-feldspar occur but it is very difficult to distinguish them under the microscope, due to the irregular spotty patterns and soft border-lines of lesser amount of K-feldspar in dominant plagioclase crystals *(Fig. 30.2).*

As the electron-microprobe investigation shows the clinopyroxene has not zonal composition. Its composition varies in narrow range *(Fig. 30.3).* It has very high CaO (24.5–25.0%) and high MgO (9.8–11.2%) and FeO* (10.3–12.3%) content, without any Na in it *(Table 30.2)*, representing ferroan diopside in the IMA classification (Morimoto 1988; Rock 1990).

Plagioclase has high An content (67.3–85.3%) representing compositions from labradorite to bytownite *(Table 30.3; Fig. 30.4).* K-feldspar generally occurs as irregular spots inside the plagioclase. K-feldspar has very high Or (90.9–93.7%) and relatively low Ab (3.6–6.1%) and An (1.9–4.0%) content *(Table 30.4).*

The microscopic texture features, combined with the results of electron microprobe analysis, show the non equilibrium rock stage as it usually can be observed in several contact metamorphic rocks.

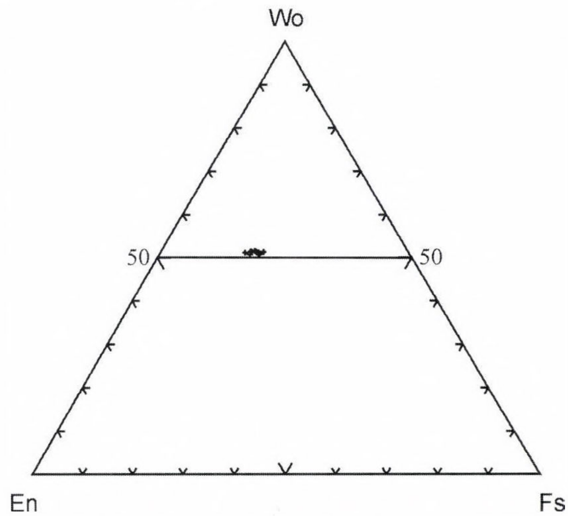


Fig. 30.3. Plot of analysed pyroxene in the En-Wo-Fs triangular diagram

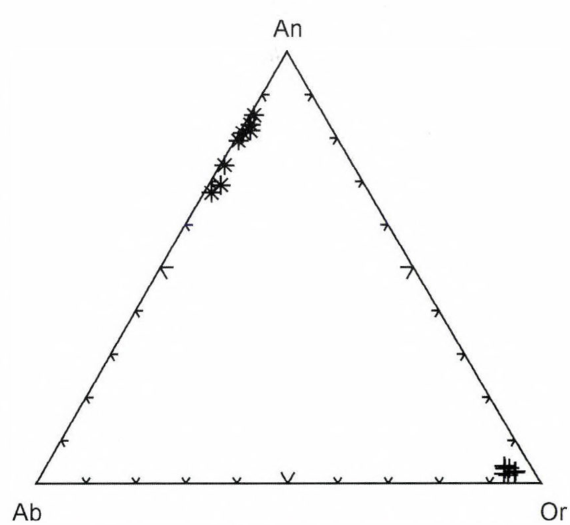


Fig. 30.4. Plot of analysed plagioclase and K-feldspar in the Ab-An-Or triangular diagram

Archaeometrical discussion

Hornfels as a raw material of polished stone tools is widely distributed in the Carpathian Basin (Hovorka *et al.* 2001), especially among the Hungarian polished stone tool kit, but their proportion is only some percent concerning all stone tools. Hornfels stone tools are more frequent in the

Table 30.2. Composition of clinopyroxene (w%)

Mineral	cpx	cpx	cpx	cpx	cpx	cpx	cpx	cpx	cpx	cpx	cpx	cpx
No of anal	**A01**	**A02**	**A03**	**A04**	**A05**	**C01**	**C02**	**C03**	**C04**	**C05**	**C06**	**C07**
SiO_2	50.59	50.60	50.58	50.90	51.15	51.12	51.14	51.06	51.42	50.92	51.03	50.71
Al_2O_3	2.36	2.02	2.28	1.82	1.87	2.00	1.88	2.01	1.97	2.32	1.62	2.04
Cr_2O_3	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.23
FeO*	12.08	11.26	10.97	11.43	10.80	10.25	12.25	11.88	11.10	10.87	12.04	11.46
MnO	0.16	0.36	0.00	0.00	0.20	0.00	0.00	0.25	0.14	0.00	0.00	0.19
MgO	9.77	10.26	10.68	10.45	11.03	11.20	10.43	10.25	10.45	10.85	10.40	10.19
CaO	24.50	24.63	24.75	24.98	24.73	24.75	24.97	24.73	24.91	25.02	24.75	24.55
Na_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	99.46	99.13	99.26	99.58	100.11	99.32	100.67	100.18	99.99	99.98	99.84	99.37
pyroxene cation number on the basis of 6 oxygens												
Si IV	1.938	1.939	1.929	1.940	1.935	1.943	1.932	1.939	1.951	1.927	1.944	1.941
Al IV	0.062	0.061	0.071	0.060	0.065	0.057	0.068	0.061	0.049	0.073	0.056	0.059
Al VI	0.045	0.030	0.032	0.022	0.018	0.032	0.015	0.029	0.039	0.030	0.016	0.033
Fe^{3+}	0.017	0.030	0.039	0.037	0.036	0.025	0.053	0.031	0.008	0.043	0.040	0.019
Cr^{3+}	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Mg^{2+}	0.558	0.586	0.607	0.594	0.622	0.634	0.587	0.580	0.591	0.612	0.590	0.581
Fe^{2+}	0.370	0.331	0.311	0.327	0.305	0.301	0.334	0.346	0.344	0.301	0.344	0.348
Mn^{2+}	0.005	0.012	0.000	0.000	0.006	0.000	0.000	0.008	0.005	0.000	0.000	0.006
Ca^{2+}	1.006	1.011	1.011	1.020	1.002	1.008	1.011	1.006	1.013	1.014	1.010	1.007
mg-number and pyroxene end-members												
mg#	0.60	0.64	0.66	0.64	0.67	0.68	0.64	0.63	0.63	0.67	0.63	0.63
En	28.52	29.75	30.84	30.01	31.53	32.24	29.59	29.43	30.15	31.06	29.76	29.64
Wo	51.42	51.34	51.38	51.57	50.82	51.21	50.92	51.03	51.66	51.49	50.91	51.34
Fs	20.05	18.91	17.78	18.42	17.65	16.55	19.49	19.54	18.20	17.45	19.33	19.01

south-eastern parts of the Carpathian Basin (e.g. Szarvas and Endrőd: Starnini and Szakmány 1998) and reach higher proportion in the Late Neolithic in Transsylvania (Kalmar and Stoicoviciu 1990).

Up to now only macroscopic and petrographic microscopic description of hornfels polished stone tools in the Carpathian Basin are available, except for the electron-microprobe analysis of four Lengyel culture axes from Svodín, South Slovakia (Hovorka *et al.* 2001). The petrographic characteristics (mineral composition, textures) of the Ecsegfalva 23B sample are very similar to the other hornfels stone tool samples described from the Carpathian Basin (e.g. Szakmány 1996; Starnini and Szakmány 1998; Judik *et al.* 2001; Hovorka *et al.* 2001; Schléder *et al.* 2002). The composition of clinopyroxene and plagioclase in the Ecsegfalva 23B hornfels sample is very similar to the composition of clinopyroxene and plagioclase in hornfels stone tools in Svodín

Table 30.3. Composition of plagioclase (w%)

Mineral	plag	plag	plag	plag	plag	plag	plag	plag
No of anal	B04	D02	D03	D04	D05	D06	D07	D08
SiO_2	49.76	47.00	48.03	46.90	49.12	46.52	49.63	46.85
Al_2O_3	30.77	32.81	32.26	32.98	31.96	32.90	31.07	33.13
CaO	14.71	17.36	16.42	17.15	16.00	18.31	15.09	17.94
Na_2O	3.76	1.93	2.27	2.12	3.05	1.65	3.44	1.87
K_2O	0.27	0.34	0.13	0.13	0.15	0.15	0.44	0.22
Sum	99.27	99.44	99.11	99.28	100.28	99.53	99.67	100.01
feldspar cation number on the basis of 8 oxygens								
Si	2.294	2.177	2.221	2.174	2.246	2.157	2.282	2.161
Al	1.672	1.791	1.758	1.801	1.722	1.798	1.684	1.801
Ca	0.727	0.862	0.814	0.851	0.784	0.910	0.743	0.887
Na	0.336	0.173	0.204	0.190	0.270	0.148	0.307	0.167
K	0.016	0.020	0.008	0.008	0.009	0.009	0.026	0.013
feldspar end-members								
Or	1.47	1.90	0.74	0.72	0.82	0.83	2.40	1.21
Ab	31.16	16.43	19.86	18.14	25.44	13.90	28.51	15.68
An	67.37	81.68	79.40	81.13	73.75	85.27	69.10	83.12

Table 30.4. Composition of K-feldspar (w%)

Mineral	kfp	kfp	kfp	kfp	kfp	kfp	kfp
No of anal	B01	B02	B03	D01	D09	D10	D11
SiO_2	63.35	63.36	63.39	63.99	63.49	63.91	63.71
Al_2O_3	19.24	19.20	19.42	19.10	19.41	19.12	19.30
CaO	0.81	0.70	0.71	0.40	0.45	0.56	0.51
Na_2O	0.57	0.59	0.48	0.61	0.68	0.40	0.42
K_2O	15.44	15.66	15.52	16.01	15.67	15.96	15.81
Sum	99.41	99.51	99.52	100.11	99.70	99.95	99.75
feldspar cation number on the basis of 8 oxygens							
Si	2.947	2.947	2.944	2.959	2.946	2.959	2.953
Al	1.055	1.053	1.063	1.041	1.061	1.043	1.054
Ca	0.040	0.035	0.035	0.020	0.022	0.028	0.025
Na	0.051	0.053	0.043	0.055	0.061	0.036	0.038
K	0.916	0.929	0.919	0.945	0.927	0.943	0.935
feldspar end-members							
Or	90.90	91.35	92.13	92.70	91.75	93.68	93.69
Ab	5.10	5.23	4.33	5.36	6.05	3.57	3.78
An	4.00	3.42	3.54	1.94	2.21	2.75	2.54

(Hovorka *et al.* 2001), but Hovorka and his co-worker did not mention K-feldspar from stone tools from this latter locality.

The provenance of the raw material hornfels is questionable yet. To give an exact answer we need more hornfels samples (stone tools and samples from outcrops) to study in detail. The amount and distribution of the hornfels raw material among the other raw material of the polished stone tools in the Carpathian Basin suggest, that the source of the raw materials may be in the south-eastern part of the Carpathian Basin, might be the contact of banatite rocks.

Ground and other stone artefacts

Alasdair Whittle

Apart from the polished stone tools described above, and the worked obsidian and limnoquartzites described by Inna Mateiciucová in chapter 31, there was very little other lithic material, hardly surprising in an environment lacking stone (Starnini and Szakmány 1998). Apart from a few irregular fragments, two querns and a piece of a possible third were identified, along with five small stone beads. The bulk of the material came from Trench 23B.

Querns

Two fitting pieces, 11820 and 13030, were found in the same square, A14, in successive spits, 430 and 445, of the upper deposit in the North Extension of Trench 23B: thus in the centre of the dense occupation already described and discussed. Together they make a trapezoidal piece some 17.5 by 10.5 cm, and 4 cm thick, which is slightly dished and smoothed on its upper side, and rougher across its under side, faintly triangular in cross-section *(Fig. 30.5).* One end appears broken, but anciently, and it is possible that this was part of an even bigger object; the two fragments here weigh together 790 g. The material was a fine sandstone with reddish inclusions.

A larger, single piece, 13715, came from 464, in square M14, in the North Extension of 23B: thus from essentially the same deposit and area. This was 20.3 by 13.3 cm, and up to 2.5 cm thick, roughly rectangular in plan *(Fig. 30.5).* The upper side is smoother than the under side, and again slightly dished. The piece weighs 1.2 kg. The material was a yellowish sandstone.

Both examples can be seen as small, portable querns.

A smaller broken piece, 9566, came from the backfill re-excavated at the start of the 2001 season in Trench 23C, and thus from the upper fill of the XY14–15 sondage. This is 5.3 by 3.4 cm, and 3.2 cm thick, with smoother upper and under sides. The material was sandstone with quartz inclusions.

Other sandstone fragments

Seven other small fragments of apparently unmodified sandstone were recovered from the occupation deposit in 23B. Since all stone material must have been imported into the site (Starnini and Szakmány 1998), these might originally also have been part of modified objects, but of what form it is now impossible to say.

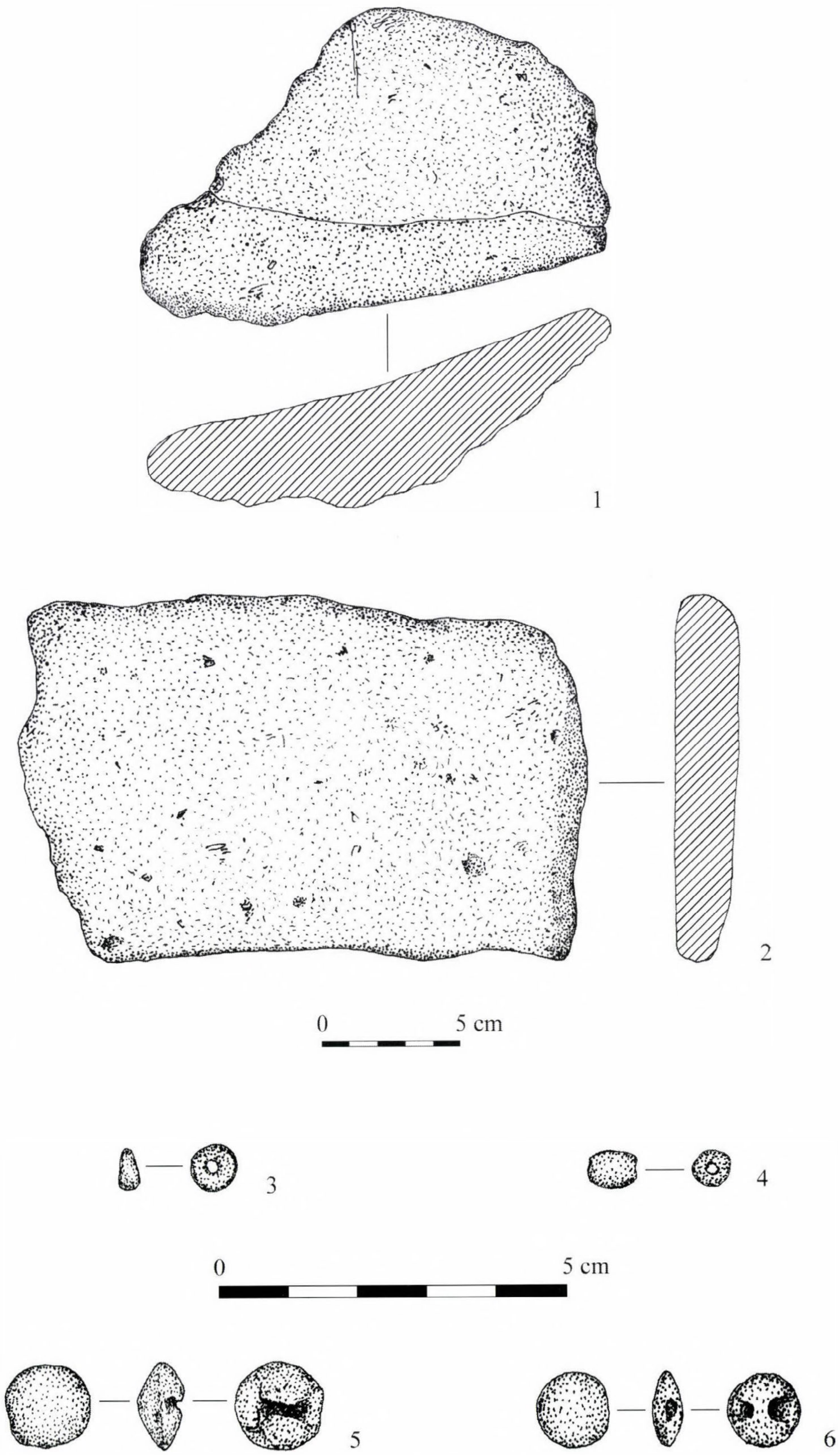


Fig. 30.5. Other stone ground stone artefacts (drawings by T. Marton)

Discussion

Starnini and Szakmány (1998) have described a quite abundant series of querns and rubbing stones from sites in the Endrőd complex excavated by János Makkay, and quern fragments were also recorded in some numbers by Andrew Sherratt in his surveys a little to the south of Ecsegfalva at Dévaványa (Sherratt 1983b). As with the figurines discussed in chapter 28, it is very difficult to get a reliable sense of relative quantities, but it may be the case that yet again equipment of this kind was less abundant at Ecsegfalva 23 than on either Dévaványa or Endrőd sites. Few other quern fragments came from the Ecsegfalva survey, and the pieces described above would certainly have been transportable, and appear smaller than most of the examples described by Starnini and Szakmány (1998) from the Endrőd complex.

Stone (or fossil shell) beads and buttons

Four examples came from Trench 23B, and one from 23A *(Fig. 30.5).*

There were two small perforated discs, 4596 and 6885, from the main occupation deposit in 23B (contexts 316 and 344 respectively). Between 6 and 6.5 mm in diameter, and 1.5 to 2 mm thick, with a central perforation of about 2 mm, these little discs were made from a fine, pale stone.

A perforated, more cylindrical example, 7 mm long and 6 mm in diameter, 6337, came from context 350 in the fill of pit 390. This was made of fine, dark stone.

Both the other examples had a perforation through their under sides. 14537 was recovered by flotation, from a sample from 464 in the upper occupation deposit of the North Extension in 23B. This is circular, 1.3 to 1.4 cm in diameter, 6 mm thick, and slightly domed on each surface in cross-section. The under side has a broken double perforation, the openings about 2.5 mm wide. The material is hard and white *(Fig. 30.5. 5).*

1172 was recovered from context 108 directly under the adult female skeleton in Trench 23A. This is circular, 1.1 cm in diameter and 4 mm thick, and slightly domed on each surface in cross-section. The under side has an intact double perforation, with openings 4 mm wide narrowing to a 2 mm perforation. The material is fine, pale, and slightly banded *(Fig. 30.5: 6).* It will be recalled that the skeleton itself has a post-Körös culture radiocarbon date (Bronk Ramsey *et al.*, chapter 10) and has been assigned to the AVK.

Although these are classed here as stone beads, it is not impossible that they are made on some kind of fossil shell. 14357 in particular is a candidate for being made of *Spondylus*.

Discussion

I know of little discussion in the literature of beads belonging to the Körös culture. At Bicske, in north-west Hungary, however, a mature adult male of the Sopot-Bicske phase of the LBK of Transdanubia was found in his grave with over 300 *Spondylus* beads; these included both cylindrical, perforated disc types and those with perforations on the underside (Makkay *et al.* 1996, 20–3, figs 7–8). The beads were reconstructed as forming a belt of some kind (Makkay *et al.* 1996, fig. 7. 6), but the under-perforated button-like ones might better be thought of as connected with clothing. Similar beads, both cylindrical and button-like, were found in quantity in the Late Neolithic hoard 1 from Csóka (Raczky 1994).

Chapter 31

WORKED STONE: OBSIDIAN AND FLINT

Inna Mateiciucová
with a contribution by *Jolanta Małecka-Kukawka*

Introduction

Over the course of the interdisciplinary archaeology project at Ecsegfalva (County Békés, Hungary), obsidian and flint artefacts were also recovered. This worked stone industry is important in the study of the Early Neolithic, since it is one of the few archaeological sources that were also produced and used in the preceding Mesolithic period. Its study can therefore not only reveal much about the customs, way of life and contacts of the Neolithic community, but by making comparisons with the worked stone artefacts of Mesolithic foragers, also permits statements about the origin of the traditions of Neolithic communities in specific regions.

Until relatively recently, only small collections of worked or chipped stone artefacts from the Körös culture were known, and as a result it has been difficult to elaborate on their characteristics (Kutzián 1944; Nepper 1970; Tringham 1971; Bácskay 1976). Large scale archaeological research conducted in the 1970s, however, has enabled the collection of rich assemblages which have been the subject of numerous studies (Kaczanowska *et al.* 1981; Bacskay and Siman 1987; Chapman 1987; Starnini 1994a; 1994b; Starnini and Szakmány 1998).

A total of 485 chipped stone artefacts were recovered from the Körös culture settlement at Ecsegfalva 23 (Trenches A, B and C). With the exception of Méhtelek-Nádas (Szatmár phase), this represents the largest assemblage recovered to date from the Körös culture.

Several questions were posed prior to analysis:

1. About origin:
Who were the inhabitants of Ecsegfalva 23? Who were the people who are known as the Körös culture? Were they early farmers who came into this region from southern Neolithic areas, or were they transformed local Mesolithic communities? In the case of the latter, how can local Mesolithic influences be identified? Were the inhabitants a combination of both, and if so, what can be designated as Mesolithic and what can be designated as Balkan-Neolithic? Specifically, is it possible to recognise local Mesolithic tradition in the production of the worked stone artefacts or does this represent the continuation of Early Balkan Neolithic patterns?

2. About lifestyle:
How did the people at Ecsegfalva 23 live? Were they above all farmers, or is it also possible to identify a range of other activities (such as hunting and fishing)? What raw stone materials were used for stone tool manufacture? Where were the sources obtained from when none were available in the immediate vicinity? How were the raw materials obtained?

Did people make expeditions to the source, or did they acquire the raw material through exchange?

What kinds of tools did they make from the stone materials? What tasks were the tools used for? Did they manufacture typical agricultural tools, such as sickle blade inserts? Did they manufacture tools, which can be specifically associated with hunting? And do the results of the stone tool analysis regarding the way of life (e.g. hunting, agriculture) agree with the results of other archaeological analyses conducted at Ecsegfalva 23?

All of these questions are closely related to the overall understanding of Neolithisation of Central Europe and the Balkans.

Attempts to clarify the process of Neolithisation based on characteristics of the chipped stone industry were renewed in the 1990s (Tillmann 1993; Gronenborn 1994, 1997; Kozłowski 1994; Mateiciucová 2001; 2002a; 2004). This paper can be understood as the continuation of the discussion that took place in Szolnok in 1996 (Kertész and Makkay 2001; Mateiciucová 2001). Results of the project at Ecsegfalva 23 offer new light.

Methods

In this study, the chipped stone artefacts from Ecsegfalva 23 were classified in terms of morphology and the raw stone materials used for their manufacture.

The classification system employed throughout this study was developed over several years, and is based on the system used in my PhD thesis (Mateiciucová 2002a) and earlier published works (Mateiciucová 1992; 1997; 2000; 2001; 2002b; 2002c). This method of classification is based on the work of Dzieduszycka-Machnikowa and Lech (1976; Lech 1981), Kaczanowska (1985), and Ginter and Kozłowski (1990). Over the years, this classification system has been gradually adapted and supplemented due to compatibility with other systems (Taute 1973/74; Zimmermann 1988; Hahn 1993). This classification system emphasises and focuses upon features related to the technology of blade production. The typology of retouched tools has also been adapted to meet the demands of specific research.

In order to ensure compatibility of the chipped stone artefact assemblage from Ecsegfalva 23 with assemblages from other Early Neolithic sites, artefacts below 12 mm in length were excluded from quantitative analysis. Gronenborn (1997) also uses this criterion in his work. The main reason for this exclusion is the assumption that sifting and flotation to obtain very small artefacts were not conducted at all sites during archaeological research. Without this exclusion, quantitative comparisons of chipped stone industry assemblages from localities with different methodologies of research result in seemingly significant differences that do not, however, relate to actual differences in the technology of manufacture. Consequently, comparisons of blade length graphs show that at some sites there are no artefacts smaller than 13 mm, whereas at others they form 10–26% of the chipped stone assemblage (Gronenborn 1997, 15, 16). Artefacts below 12 mm are instead taken into account in the second phase of analysis. Their significant representation at some settlements, or context of recovery from specific buildings, indicate areas in which blank production or the mending of tools were concentrated.

All retouched tools were included in qualitative analysis, including those which do not exceed 12 mm. The size category is denoted for all of these artefacts.

In order to evaluate the technology of blade production on the settlement, marks on blades and fragments of blades of all sizes were considered.

The stone chipped industry was also evaluated in terms of raw materials. Attention was given to identifying the provenance of stone raw materials, and was used to reconstruct the distribution network. The kinds of raw materials and their provenance were identified by macroscopic and microscopic analysis.

Macroscopic identification of stone materials was based on macroscopic comparisons with samples of raw stone materials obtained from primary sources. Colour, texture, pattern, fracture, lustre and quality were observed and compared. For macroscopic identification I used my own collection of raw material samples, as well as samples amassed at the Lithotheka (Comparative Raw Material Collection of the Hungarian National Museum) (Biró and Dobosi 1991; Biró *et al.* 2000).

The method used in microscopic analysis was developed by Přichystal (1984; 1985; 1991) for the needs of archaeologists. The advantages of this method over macroscopic procedures are the speed, reduced expense and non-destructive nature of the analysis. Nearly every ambiguous artefact can be examined this way. This method requires the use of a stereoscopic microscope with 60–100x magnification and water as immersion fluid. This permits the examination of the inner structure of the material, which cannot otherwise be seen by the naked eye, without causing any damage to the artefact. It is possible to study microfossils, plant tissue remains, pollen, mineral residues, and so on. First, this method permits the identification of raw material type, which may often be problematic macroscopically (e.g. jasper versus radiolarite). Secondly, it is also possible to identify the original provenance based on the characteristic microstructure and microfossils. It is important however, to also conduct comparisons with thin sections and samples of stone raw materials from primary sources.

Criteria for the selection of chipped stone artefacts

For the study of chipped artefacts from Ecsegfalva 23, stone tools recovered from the area Ecsegfalva 23B and Ecsegfalva 23C were selected for examination *(Tables 31.1–3, 6).* Both areas were settled only in the period of the Körös culture. Since other Neolithic settlement was not identified elsewhere in these areas of the site, artefacts from the topsoil layer were also included for study. This is not true for all areas of the site. In Trench 23A, for example, AVK occupation is documented by the burial of a woman and AVK pottery, above Körös culture features. Although a total of 20 chipped stone tools (including seven below 12 mm) were recovered from Trench 23A, this set of stone tools was not included in the overall analysis of Körös chipped stone artefacts from Ecsegfalva 23.

Results

The resulting assemblage of chipped stone artefacts selected for study comprises 463 artefacts (including 112 below 12 mm) *(Tables 31.1–2).*[1] Most of the tools were recovered from Trench 23B, comprising a total of 411 artefacts (including 104 below 12 mm). The remaining 52 chipped stone artefacts (including eight below 12 mm) were recovered from Trench 23C.

Raw material

Similar to other Körös culture sites, the inhabitants of the settlement at Ecsegfalva 23 suffered from a lack of local raw stone materials. Consequently, raw stone materials were procured from a distance (*Table 31.4* and *Fig. 31.10*).

Table 31.1. Ecsegfalva 23B and 23C, Körös culture.
Chipped stone artefacts > 12 mm divided into basic blank groups

Blank groups	No. of pieces (> 12 mm)	%	Blanks (> 12 mm)	Tools (> 12 mm)
Pre-cores and cores	13	3.7	11	2
Flakes and waste	161	45.9	156	5
Blades and blade fragments	177	50.4	152	25
Total	**351**	**100**	**319**	**32**

Table 31.2. Ecsegfalva 23B and 23C, Körös culture.
Chipped stone artefacts ≤ 12 mm divided into basic blank groups

Blank groups	No. of pieces (≤ 12 mm)	%	Blanks (≤ 12 mm)	Tools (≤ 12 mm)
Pre-cores and cores	1	0.9	1	
Flakes and waste	72	64.3	70	2
Blades and blade fragments	39	34.8	38	1
Total	**112**	**100**	**109**	**3**

Table 31.3. Ecsegfalva 23B and 23C, Körös culture.
Basic morphological groups of the chipped stone artefacts

Basic morphological groups	No. of pieces (> 12 mm)	%	No. of pieces (≤ 12 mm)
Pre-cores and cores	11	3.1	1
Flakes and waste	156	44.4	70
Blades and blade fragments	152	43.3	38
Tools	32	9.1	3
Total	**351**	**99.9**	**112**

Two kinds of raw stone materials dominate the Ecsegfalva 23 chipped stone tool assemblage: limnic quartzites and Carpathian obsidians (*Table 31.4* and *Fig. 31.11*). Both originate from areas that lie north of the site, where no Körös culture or other Early Neolithic settlements have been uncovered.

Limnic quartzites form the majority (60%) of the Ecsegfalva chipped stone tools. Lighter coloured variants – white, beige, yellow, light brown and light grey sometimes with orange and reddish streaks – occur most frequently. Based on the raw stone material samples housed at Lithotheka in the Hungarian National Museum of Budapest (Biró and Dobosi 1991; Biró *et al.* 2000), and samples collected by myself, I suggest that these colours are typical for limnic quartzite sources in the area of the Tokaj Mountains. Limnic quartzites found at Méhtelek-Nádas also clearly come from the Tokaj Mountains (Starnini 1994a, 69). Similar limnic quartz-

Table 31.4. Ecsegfalva 23B and 23C, Körös culture. The proportion of raw materials and the distances from their primary sources

Raw material	No. of pieces (> 12 mm)	%	No. of pieces (≤ 12 mm)	Distance
Limnic quartzite	127	36.2	35	110–120 km
Mezőzombor limnic quartzite	83	23.6	10	110–120 km
Carpathian obsidian I	110	31.3	61	150–160 km
Carpathian obsidian II	2	0.6		110–120 km
Carpathian obsidian – overburnt	2	0.6		
Szentgál radiolarite	1	0.3	1	240 km
Radiolarite	2	0.6		
Banat flint	2	0.6		
Volhynian flint	1	0.3		430–500 km
Porzelanite	1	0.3		110–120 km
Quartz	3	0.8		
Burnt	13	3.7	5	
Other	4	1.1		
Total	**351**	**100**	**112**	

Table 31.5. Ecsegfalva 23B and 23C, Körös culture. The proportion of raw materials in the basic morphological groups

Raw material	No. of pieces (> 12 mm)	%	Pre-cores and cores	Flakes	Blades	Tools	No. of pieces (≤ 12 mm)	Pre-cores and cores	Flakes	Blades	Tools
Limnic quartzite	106	59.8	2	46	51	7	35		23	12	
Mezőzombor limnic quartzite	53		5	26	17	5	2		2		
Mezőzombor limnic quartzite?	30			14	14	2	8		3	5	
Limnic quartzite – overburnt	14			14							
Limnic quartzite?	7			5	2						
Carpathian obsidian I	106	32.4	3	31	60	12	60	1	36	20	3
Carpathian obsidian I ?	4		1	1	2		1			1	
Carpathian obsidian II	1			1							
Carpathian obsidian II ?	1			1							
Carpathian obsidian – overburnt	2			2							
Szentgál radiolarite	1	0.3		1			1		1		
Radiolarite	2	0.6		1	1						
Banat flint	2	0.6		1		1					
Volhynian flint	1	0.3			1						
Porzelanite	1	0.3				1					
Quartz	3	0.8		2		1					
Burnt	13	3.7		7	3	3	5		5		
Others	4	1.1		3	1						
Total	**351**	**100**	**11**	**156**	**152**	**32**	**112**	**1**	**70**	**38**	**3**

ites were also found at the Körös culture site of Endrőd 39,[2] although their source is in the Mátra area (approximately 100 km away) (Starnini and Szakmány 1998, 298). A notable group of Ecsegfalva 23 chipped stone artefacts were also made from so-called Mezőzombor limnic quartzites *(Table 31.5)*[3] with a source in the South Tokaj area (Biró 1998, 32). These limnic quartzites are characterised by grey, cream, light brown, and lemon yellow, fine striped variants. Mezőzombor limnic quartzites account for nearly half of all chipped stone artefacts made from limnic quartzites (c. 40%) at Ecsegfalva *(Fig. 31.11. 7–8)*. This type of limnic quartzite was probably preferred over other limnic quartzites for its superior quality and bright colouring.[4]

Obsidian is the second most common raw material (32.5%) at Ecsegfalva and originates predominantly from the Slovakian side of the Tokaj-Zemplén Mountains, approximately 150–160 km away from Ecsegfalva *(Fig. 31.10)*. The dark grey to black, translucent to transparent variety of obsidian, so-called Carpathian obsidian 1 (Kaminská 1991, 19, Obr. 5; Biró 1998, 33) is characteristic of obsidian on the Slovakian side of the Tokaj-Zemplén Mountains.

Only a few examples of obsidian at Ecsegfalva 23 are more typical of the closer sources in north-eastern Hungary. These comprise the non-transparent, grey to dark grey, fine striped Carpathian obsidian 2E from the Mád Mountains (between Mád and Erdőbénye, 110–120 km away). Black non-transparent Carpathian obsidian 2T from the Tokaj Mountains (Tolcsva area) (Biró 1998, 32–33) was not found at Ecsegfalva.

While at Ecsegfalva 23 limnic quarzites are very numerous and comprise two-thirds of all used raw stone materials, Carpathian obsidians and Banat flint (as seen at Endrőd 39) were preferred at other settlements of the Körös culture (Kaczanowska *et al.* 1981; Starnini and Szakmány 1998, 290). In the transitional phase from the Körös culture to the AVK – the Szatmár phase – not only does settlement shift further to the north, but so does stone source preference which becomes concentrated on the exploitation and processing of obsidian (Méhtelek-Nádas and Tiszacsege-Homokbánya) (Starnini 1994a; 1994b).

The identity of the people that inhabited the northern regions at the time of the Ecsegfalva settlement is still unclear. Mesolithic settlement in the northern regions occurs very sporadically. In the 1990s new Mesolithic settlements were discovered in the Jászság area (Jászberény I, Jásztelek I) to the north of Szolnok and some 60–70 km north-west of Ecsegfalva. The C14 dating of layer C at the Mesolithic site Jászberény I indicates occupation during the latter half of the Boreal period[5] (Kertész *et al.* 1994, 28). The stratigraphical position and typological analysis of layer B2 of Jászberény I share similarities with the site Jásztelek I, and both are classified as Late Mesolithic (Kertész 1994, 26; Kertész *et al.* 1994, 19, 28, 31). There are also younger sites than Jásztelek I in the Jászság area, but unfortunately these have only yielded surface finds (Róbert Kertész, *pers. comm.*). It is probable that Mesolithic people contemporaneous with the Körös culture settled the northern areas. The Mesolithic communities of the Jászság area predominantly used limnic quarzite from the Mátra Mountains in northern Hungary. Carpathian obsidian appears rarely *(Fig. 31.9)* (Kertész *et al.* 1994, 24, 29). Carpathian obsidian was preferred at the Early Mesolithic site of Barca I in eastern Slovakia (Bárta 1965, 162; Kozłowski 1981, 301). In the Late Mesolithic (or Early Neolithic?), hunters in eastern Slovakia left a bone point with blade inserts manufactured from limnic quartzite *(Fig. 31.12. 11)*, which had been undoubtedly made by pressure, in the Bear cave (Medvedia jaskyňa) of Ružín. The technique of pressure applied during manufacture and the appearance of the blades seems unique in the Mesolithic of Slovakia and Hungary. The closest analogies are known in the area of the Janislawice culture in the Late Mesolithic. These blades, and the Janislawice culture itself, can be associated with influence from the Pontic area (the northern Black sea area and Crimea), especially with the Kukrek and Grebeniki cultures (Bárta 1989, 458–60; 1990, 21, figs 6 and 7; Domańska 1990a; 1990b). Unfortunately no C14 dates are currently available.

Four additional raw materials were employed in stone tool manufacture at Ecsegfalva 23 beside Carpathian obsidian and limnic quartzite. These include Banat flint, Volhynian flint, Szentgál radiolarite and porzelanite *(Fig. 31.10)*.

Banat flint, so characteristic of Körös and Starčevo culture settlements, was identified in two examples *(Fig. 31.11. 14, 16)*, and provides evidence of southern connections to the Balkan Neolithic. The primary source of Banat flint is thought to be in the western Banat or in the Romanian Banat due to larger concentrations of this source in these regions (the 'Pre-Balkan plateau') (Kaczanowska *et al.* 1981, 107; Biró *et al.* 2000, 118). Banat flint is associated with large long blades (for example Lepenski Vir III; Golokut, Endrőd 119, Endrőd 39, Endrőd 35, Méhtelek-Nádas) (Kozłowski and Kozłowski 1984, 271; Kaczanowska and Kozłowski 1985; Starnini 1994b; Starnini and Szakmány 1998). However, at Ecsegfalva 23, only a small flake and a fragment of a lateral retouched blade made of Balkan flint were found.

One blade was made from Volhynian flint *(Fig. 31.15. 3)*, which indicates contacts to east – to the Prut and Dniestr valley – and could have come to Ecsegfalva through exchange with Criş culture communities *(Fig. 31.10)*.

Western contacts, probably to Starčevo culture communities, are indicated by two flakes of Szentgál radiolarite *(Fig. 31.11. 15)*. Isolated artefacts made from Szentgál radiolarite were also found at Méhtelek-Nádas and Tiszacsege-Homokbánya in association with the transition Szatmár phase (Starnini 1994b, 102–03). The primary source of the Szentgál radiolarite lies to the west of Ecsegfalva (c. 240 km away), in the Bakony Mountains in North Transdanubia. A supposed centre of the emergence of the Linear Pottery Culture (LBK) is located in this area. Therefore Szentgál radiolarite plays a key role in the study of the process of Neolithisation in Central Europe (Gronenborn 1994; 1997; Mateiciucová 2002a; 2002b; 2004; Bánffy 2004, 379–80).

Bakony radiolarite (the main variety of Szentgál) was heavily exploited from the late phase of the Starčevo culture (Gellénháza-Városrét, Vörs-Máriaasszony-sziget) and continued in the Early LBK (Szentgyörgyvölgy-Pityerdomb, Bicske-Galagonyás, Hidegkút, Veszprém-Nándortelep, Budapest-Aranyhegyi út, Neckenmarkt, Brunn IIa, Brunn IIb, Brunn III, Brunn IV) (Biró 1987, 145–46; 1998, 46, 48; 2002, 122–25; Makkay *et al.* 1996, 158; Gronenborn 1997, 20; Mateiciucová 2002a, 284–85; 2002b, 174–76). Earlier, Szentgál radiolarites had been preferred by Late Mesolithic communities in Transdanubia (Kaposhomok) (Marton 2003). Individual artefacts manufactured from Szentgál radiolarite are also known from the Late Mesolithic sites in northern Hungary (Jásztelek I: layer A, B and feature I; Jászberény II: surface; Jászberény III: surface) (Mateiciucová 2002a, 284).

One end-scraper was made from greyish white porzelanite probably from Mád Mountain (A. Přichystal, *pers. comm.*).

Raw material supply and processing of chipped stone artefacts

At Ecsegfalva 23, flakes, waste and blades are represented in almost equal proportions *(Table 31.3)*. In the category of pre-cores and cores, residual forms of blade cores dominate. Also among tools, items made from blades dominate. The overall production of the chipped stone industry at Ecsegfalva 23 can be characterised as blade blank production.

Assemblages dominated by blades and tools manufactured from blades as opposed to cores and flakes are typical for settlements located far from primary stone sources. These settlements usually obtained the required raw stone sources via expeditions to the source itself, or via exchange with settlements closer to the source. Lech designates the settlements far from the source as settlements of users (Lech 1981, 130–33; 1989). Such settlements usually acquired stone sources in the form of prepared pre-cores, cores, blade blanks and ready tools (Lech 2003, 22). Blade production on such settlements usually only entailed production for the household or personal use. However, when the raw material supply and processing of the chipped stone artefacts of Ecsegfalva 23 are examined in terms of individual raw stone sources and compared with other Körös and Starčevo culture sites, two different distribution patterns can be observed. These two patterns can be separated geographically into:

1. a 'Danubian' pattern, which supplied the settlement with limnic quarzite, obsidian and Szentgál radiolarite. Materials from this network dominate at Ecsegfalva;
2. a 'Balkan' pattern, which supplied the settlement with blades and tools manufactured from Balkan flint.

Raw material acquired through the 'Danubian' pattern was probably obtained through exchange in the form of pre-cores and cores. The required tools were then manufactured directly on the settlement. However, there may also have been expeditions to the primary source or to settlements which served as primary production centres (Lech 1981, 124–26). These expeditions may have been associated with additional activities in these regions (hunting, exchange of other raw material and products, and so on). This method of obtaining raw material is common in the Neolithic of Central Europe and is characteristic of the Early LBK culture. The Danubian distribution pattern dominated at both Ecsegfalva 23 and settlements of the Late Starčevo culture (Gellénháza-Városrét,[6] Vörs-Máriaasszony-sziget). However, although in the LBK stone sources were distributed from regions with LBK settlements, it is important to stress that the stone sources (limnic quarzite, obsidian and Szentgál radiolarite) obtained by the occupants of Ecsegfalva 23 and other Körös and Starčevo culture communities were acquired from regions which were not settled by Neolithic communities at the time.

Contrary to the Danubian distribution pattern, the Balkan pattern is more associated with the distribution of finished products (blades and tools). The absence of cores and only restricted quantities of flakes and waste in the Körös and Starčevo culture settlements indicate that the production of robust long blades from Banat flint took place outside the settlement.[7] The uniformity of blade blanks indicates specialised production in specialised workshops. Robust long blades from Banat flint indirectly indicate that the raw material was quite large in size. Although the primary sources have not yet to be identified, researchers suggest Banat flint was mined (Starnini and Szakmány 1998, 311).

These presumptions suggest a range of additional questions. Where were the specialised workshops situated? Did they exist near the mines or were there specialised settlements for Banat flint processing? Can specialised production be expected in the Early Neolithic period? Were the produced blade blanks distributed by a stable organised exchange network?

At Ecsegfalva 23, only one highly used blade and small flake made from Balkan flint were identified. Ecsegfalva 23 therefore participated in the Balkan distribution network, which was a part of the Neolithic communication network, and had social ties with the Balkans.

Settlements of the Körös and Starčevo cultures are distinguished by restricted numbers of worked or chipped stone artefacts. Settlements which include large-sized chipped stone artefacts, mainly in the form of robust blades and blade tools, have yielded only several dozen chipped stone tools (Bacskay and Siman 1987; Starnini and Szakmány 1998). On the other hand, settlements where small-sized chipped stone tools predominate, have yielded more numerous assemblages of chipped stone artefacts (such as Ecsegfalva 23 and Gellénháza-Városrét). This difference can be associated with the above stated strategies in processing and distribution of raw stone material, as well as with the varied life and function of the end products (especially of blades and blade tools). Robust blades served as multi-functional tools (Starnini 2001, fig. 3; and see the contribution by Jolanta Małecka-Kukawka below) and their use life was longer than that of small-size blades. On the contrary, small-size blades and tools were damaged and broken more frequently, and therefore had to be repaired and replaced by new products more often. For this reason, assemblages of small-sized chipped stone tools are more numerous.

Technological and morphological analysis of chipped stone artefacts

Pre-cores and cores (Table 31.7)

Altogether two pre-cores and 11 cores were found (3.1%; including tools 3.7%). One quartz pebble was also included in this category. The pre-cores were made from limnic quartzite *(Table 31.8)*. The cores were manufactured from limnic quartzite and Carpathian obsidian 1 (*Table 31.9* and *Fig. 31.14*). All cores are small (average 22.8 mm and 7.6 g) and were mostly used for the production of blades. They mainly have only one prepared striking platform. No cores with dorsal reduction were identified.

Table 31.6. Ecsegfalva 23B and 23C, Körös culture. Weight of chipped stone artefacts

Basic morphological groups	No. of pieces	Weight (g)	Avg (g)	Limnic quarzite (g)	Obsidian (g)
Pre-cores and cores	11	179.5	16.3	148.5	31
Flakes and waste	156	335.2	2.2	271.5	42.1
Blade and blade fragments	152	108.9	0.7	66.7	38.2
Tools	32	187.9	5.9	35	7.1
Total	**351**	**811.5**	**2.3**	**521.7**	**118.4**

Table 31.7. Ecsegfalva 23B and 23C, Körös culture. Pre-cores and cores

Core type	No. of pieces	Blanks (n)	Tool (n)
Unworked nodules	1	–	1
Pre-core	2	2	–
Core	10	10	–
Splintered pieces	1	–	1
Core fragment	–	–	–
Total	**14**	**12**	**2**

Table 31.8. Ecsegfalva 23B and 23C, Körös culture. Pre-cores

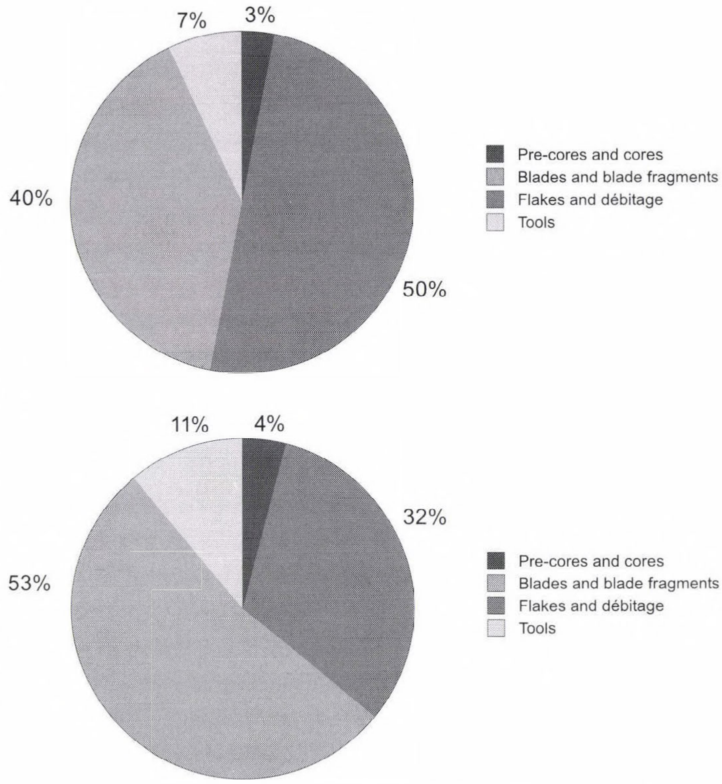
No.	Raw material	Preparation	Height	Width	Thickness	Weight	Tool
1	Quartz	Unworked raw material	72.5	49	28	n130	hammerstone
2	Limnic quartzite	Single prepared raw material	65	0	0	80.1	–
3	Mezözombor limnic quartzite	Pre-core with prepared striking platform	33	24	24	28.4	–

Table 31.9. Ecsegfalva 23B and 23C, Körös culture. Basic characteristics of cores

No.	Raw material	Type of blanks	No. of platforms	Shape	Striking platform preparation	Dorsal reduction	Platform angle	Height	Width	Thickness	Weight	Tool
1	Limnic quartzite	flake core	–	irregular	–	–	–	30	0	0	9.9	–
2	Carp. obsidian I	blade core	single	flat	faceted	no	right	22.5	17	8.5	3.4	–
3	Limnic quartzite	flake-blade	single	flat	faceted	no	right	25	29.5	15.5	13.4	–
4	Limnic quartzite	blade core	single	keel-formed	rejuv. by single blow	no	acute	21	13	7	2.6	–
5	Mezözombor limnic quartzite	blade core	single	keel-formed	rejuvenated – faceted	no	acute	28	14	19	5.3	–
6	Carp. obsidian I	flake-blade	with changed orient.	prismatic	rejuv. by single blow	no	–	35.5	18	34	24	–
7	Mezözombor limnic quartzite	blade core	single	prismatic	rejuv. – prepared	no	acute	20.5	22	22	8.8	–
8	Carp. obsidian I	flake-blade	single	conical	faceted	no	right	13	11.5	9	1.4	–
9	Carp. obsidian I	flake-blade	single	semiconical	faceted	no	right	11	13	8	1.1	–
10	Carp. obsidian I	flake-blade	two-residual	flat ?	indeterminate	–	–	14	16	9	2.2	–
11	Mezözombor limnic quartzite	–	–	splintered p.	–	–	–	30.5	19	15.5	11.7	hammerstone

Flakes and waste

Flakes and waste form less than one half of the collection (44.4%; including tools 45.9%). In this category, about two-thirds of the artefacts were manufactured from limnic quartzite and one quarter was manufactured from obsidian. Flakes are small (average length 20 mm and width 16 mm), and usually without a cortex and no visible traces of use (*Tables 31.10–14* and *31.25*). Seven technical flakes were identified (1 of obsidian and 6 of limnic quartzite) connected with core preparation during production of blades (flaking surface rejuvenation flake, striking platform rejuvenation flake, crested blades). Tools were made only out of five flakes.



Figs 31.1–2. Ecsegfalva 23B and 23C, Körös culture. Basic morphological groups of the chipped stone artefacts

Blades and blade fragments

The production of stone tools was primarily oriented toward blade production, as indicated by the presence of retouched tools predominantly consisting of blades, as well as blades with traces of use. A similar tendency is also evident at other Körös culture settlements. This category of blades accounts for approximately 43.3% of the assemblage (and including blade tools 50.4%). The blades are to a large extent manufactured from obsidian or from limnic quartzite (*Figs 31.11* and *31.14–16*).

It is remarkable that at Ecsegfalva 23 mostly small and narrow blades occur, which is distinct from the majority of settlements of the Körös culture *(Tables 31.15–19)*. The different size of blades may relate to different traditions (see below) or perhaps has to do with the original size of the blanks. There are no great differences between blades manufactured from obsidian and blades manufactured from limnic quartzite. The average length of a complete blade is 27 mm (range 15–57 mm).

Blades are mostly regular with primarily faceted platform remnants, without dorsal reduction *(Table 31.20)*. Blades manufactured from limnic quartzite indicate also plain platform remnants, likewise without dorsal reduction. The platform remnant angle is nearly always between 85–95 degrees *(Table 31.21)*. Blades were often bent in the distal parts of lateral profile, which made sometimes s-shaped profiles *(Table 31.22)*. The distal part is usually just as thick or thicker than the basal part. All these characteristics suggest the use of the punch technique in the production of blades (Mateiciucová 2002a, 236, fig. 6. 1). Similar blades were manufactured in the Late Starčevo culture (Gellénháza-Városrét, Vörs-Máriaasszony-sziget) and in the Earliest LBK (for example Brunn IIa, Brunn IIb, Szentgyörgyvölgy-Pityerdomb)[8] (Biró 2002, 122–25; Mateiciucová 2002a; 2002b).

It is remarkable that it is predominantly obsidian blades that carry intensive traces of use *(Table 31.26)*. In contrast to this, traces of use rarely appeared on blades manufactured from limnic quartzite. This difference may be related to the physical characteristics of the raw material.

Table 31.10. Ecsegfalva 23B and 23C, Körös culture. Type of flake and flake tools

Type of flake	No.	%	Flakes	Tools	Obsidian	Limnic quartzite
Preparation flake	80	49.7	79	1	20	58
Blade-like flake	4	2.5	4			2
Ridge flake	4	2.5	4			4
Flaking surface rejuvenation flake	1	0.6	1		1	
Striking platform rejuvenation flake	1	0.6	1			1
Rejuvenated flake from a core's base	1	0.6	1			1
Primary flake	2	1.2	2			1
Waste	61	37.9	59	2	13	37
Natural fragment	4	3.1	4	1	2	2
Indeterminate	2	1.2	1	1		2
Total	**161**	**99.9**	**156**	**5**	**36**	**109**

Table 31.11. Ecsegfalva 23B and 23C, Körös culture. Degree of preservation of natural surface on flakes including retouched tools

Surface of flakes and flake tools	No. of pieces	%	Obsidian	Limnic quartzite
Cortical	9	5.6	1	5
Partly cortical	57	35.4	15	39
Without a cortex	95	59	21	85
Total	**161**	**100**	**37**	**109**

Table 31.12. Ecsegfalva 23B and 23C, Körös culture. Length of preparation and blade-like flakes (including flake tools)

Length	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Flakes	83	12.5	39	20.2	7
Flake tools	1	12.5	12.5	12.5	0

Table 31.13. Ecsegfalva 23B and 23C, Körös culture. Width of preparation and blade-like flakes (including flake tools)

Width	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Flakes	83	6.5	42	16.3	6,8
Flake tools	1	10	10	10	0

Table 31.14. Ecsegfalva 23B and 23C, Körös culture. Thickness of preparation and blade-like flakes (including flake tools)

Thickness	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Flakes	83	1.5	14.5	5.2	2.9
Flake tools	1	3	3	3	3

Table 31.15. Ecsegfalva 23B and 23C, Körös culture. Type of blades and blade tools (including blade fragments ≤ 12 mm)

Typ of blade	Blades (n)	Blade tools (n)
Whole blade	25	1
Blade with broken distal part	35	9
Blade with broken basal part	13	
Blade with broken distal and basal parts	8	2
Basal fragment of blade	48	1
Mesial fragment of blade	30	13
Distal fragment of blade	25	1
Fragment of crested blade	1	
Fragment of secondary crested blade	2	
Fragment of burin blade	1	
Total	**188**	**27**

Table 31.16. Ecsegfalva 23B and 23C, Körös culture. Degree of preservation of natural surface on flakes including retouched tools

Surface	No. of pieces	%	Obsidian	Limnic quartzite
Cortical	3	1.7	0	3
Partly cortical	44	24.9	15	29
Without a cortex	130	73.4	59	61
Total	**177**	**100**	**74**	**93**

Table 31.17. Ecsegfalva 23B and 23C, Körös culture. Length of whole blades and blade tools

Length	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Blades	25	15	57	26.7	8.8
Blade tools	1	27	27	27	0

Table 31.18. Ecsegfalva 23B and 23C, Körös culture. Width of whole blades, of blades with broken distal part, of blades with broken basal part and of blades with broken distal and basal parts

Width	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Blades	85	4	19	10.2	3.2
Blade tools	11	9	20	12	3.5

Table 31.19. Ecsegfalva 23B and 23C, Körös culture. Thickness of blades with preserved basal part

Thickness	No. of pieces	Min (mm)	Max (mm)	Avg (mm)	StDev (mm)
Blades	109	1	8	3.3	1.2
Blade tools	10	2.5	7	4,1	1.6

Tools

At Ecsegfalva 23, a total of 35 (including three below 12 mm) retouched tools were found, constituting 9.1% of the assemblage. Tools were predominantly made from blades *(Table 31.23)*. Obsidians and limnic quartzites were used for manufacture in equal proportions *(Table 31.24)*. In addition, a lateral retouched blade was made from Banat flint and an end-scraper from porzelanite. The raw material of three further tools could not be determined due to burning. One hammerstone was made of quartz. In the category of tools, two types dominate: truncated blades and trapezes.

Truncated blades and end-scrapers

Altogether nine tools were assigned to the category of truncated blades *(Fig. 31.16. 5, 6, 8, 9, 16, 24)*. Six of them were made of obsidian, and two from limnic quartzite. The raw material of one blade was burnt and thus could not be identified. Eight out of of the nine truncated blades were retouched only on one end. Only one tool manufactured from obsidian was retouched on both ends and resembles a long trapeze *(Fig. 31.16. 24)*. Truncated blades were mostly retouched dor-

Table 31.20. Ecsegfalva 23B and 23C, Körös culture. Type of platform remnants and occurrence of dorsal reduction of blades and blade tools

Platform remnant	Total		%		Obsidian		Limnic quartzite	
Dorsal reduction	**yes**	**no**	**yes**	**no**	**yes**	**no**	**yes**	**no**
Natural	0	1					0	1
	1		0.8		0		1	
Plain	4	15			0	1	2	14
	19		15,4		1		16	
Prepared	0	4					0	4
	4		3.3		0		4	
Punctiform	4	9			2	7	1	2
	13		10.6		9		3	
Primary faceted	5	71			4	30	1	38
	76		61.8		34		39	
Secondary prepared	0	7			0	3	0	4
	7		5.7		3		4	
Unidentified	3		2.4		1		2	
Total	**123**		**100**		**45**		**69**	

Table 31.21. Ecsegfalva 23B and 23C, Körös culture. Frequency of platform remnant angles of blades and blade tools

Platform remnant angle of blades and blade tools	No. of pieces	%	Obsidian	Limnic quartzite
Acute (< 85°)	11	10.8	2	9
Right (85° – 95°)	87	85.3	35	46
Obtuse (> 95°)	0	0		
Indeterminate	4	3.9		4
Total	**102**	**100**	**24**	**59**

Table 31.22. Ecsegfalva 23B and 23C, Körös culture. Lateral profile of blades and blade tools

Lateral profile	No. of pieces	%	Obsidian	Limnic quartzite
Straight	8	12.9	4	4
Bent – evenly	19	30.6	9	9
Bent – in the mesial part	8	12.9	2	6
Bent – in the distal part	17	27.4	4	12
S-bent	8	12.9	2	5
Twisted	1	1.6	1	
Indeterminate	1	1.6		1
Total	**62**	**99.9**	**22**	**37**

Table 31.23. Ecsegfalva 23B and 23C, Körös culture. Type of tools in the relation to the blanks (including tools ≤ 12 mm)

Type of tool	Total	Cores	Flakes	Blades
End-scraper	2			2
Truncated blades	9			9
Burins	2			1 + 1 ?
Lateral retouched blades	2			2
Borers/ perforators	2			2
Notched and denticulated pieces	2		1	1
Side-crapers	1		1	
Trapeze	6			6
Trapeze points	1			1
Splintered pieces	3	1	2	
Combination tools				
Hammer-stones	2	1	1	
Fragments of tools	3		2	1
Total	**35**	**2**	**7**	**26**

Table 31.24. Ecsegfalva 23B and 23C, Körös culture. Type of tools (including tools ≤ 12 mm)

Type of tools		Total	Obsidian	Limnic quartzite	Others
End-scrapers		**2**	**1**		**1**
	on a blade	1			
	on a retouched blade	1	1		1 (porzel.)
Truncated blades		**9**	**6**	**2**	**1**
	oblique concave	1		1	
	oblique convex	2	1		1 (burnt)
	oblique convex-ventral	2	2		
	transverse straight	2	2		
	transverse convex	1	1		
	on both ends oblique – trapeze formed	1		1	
Burins		**2**	**1**	**1**	
	truncation burin			1	
	on a broken end – pseudoburin ?	1	1		
Lateral retouched blades		**2**		**1**	**1**
	unilateral steep – ventral	1		1	
	bilateral unbroken – dorsal a. ventral	1			1(Banat)
Borers/perforators		**2**	**1**	**1**	
	thin borer with a weakly distinguished point	1		1	
	fragment of a borer	1	1		
Notched and denticulated tools		**2**	**1**	**1**	
	fragment of a notch	2	1	1	
Side-scrapers		**1**		**1**	
Trapezes		**6**	**3**	**2**	**1**
	short – dors. ret.	1	1		
	short – half dors. ret. + dors. and ventr. ret.	1		1	
	short – dors. ret. + dors. and ventr. ret.	1	1		
	short – dors. ret. + dors. and ventr. ret.	1	1		
	long – half dors. ret. + dors. and ventr.ret.	1			1(burnt)
	long – dors. ret. of corner + dors. ret.	1		1	
Trapeze points		**1**		**1**	
Splintered pieces		**3**		**3**	
Combination tools		**0**			
Hammerstones		**2**			**2**
	fragment of hammerstone	2			1(burnt), 1(quarz)
Fragments of tools		**3**	**2**	**1**	
Total		**35**	**15**	**14**	**6**

sally, and only two were modified by ventral retouch. Two end-scrapers were found. One of them was made from obsidian and other one from porzelanite *(Fig. 31.16. 3)*.

The line of distinction between truncated blades and blade end-scrapers partly overlaps. The ratio of truncated blades and blade end-scrapers is related to a certain extent with the original width of the blade blanks. Truncated blades originated on narrow blades and end-scrapers on wide blades. Truncated blades and end-scrapers also occur on other sites of the Körös culture. Körös culture and Szatmár phase sites dominated by small-sized blades indicate the predominance of truncated blades (Dévaványa 26, Méhtelek-Nádas) (Bacskay and Siman 1987, 121; Starnini 1994a, 38), whereas localities dominated by large-sized chipped stone tools are dominated by blade end-scrapers (Hódmezővásárhely-Kotacpart, Tiszacsege) (Bacskay and Siman 1987, 118–19, 121; Starnini 1994b). In the Starčevo culture, both types of tools are more rare (Kaczanowska and Kozłowski 1985; Gronenborn 1997, 103). End-scrapers also dominate in the Vinča culture (Kaczanowska and Kozłowski 1986; Kaczanowska 1989, 130). End-scrapers were often manufactured in the LBK culture. More significantly, truncated blades occur only in the Early LBK, and only in some mainly eastern regions (mostly in Transdanubia, Lower Austria and the Main area).[9] In the later phase of the LBK, end-scrapers became a typical part of tool sets throughout the area of the LBK; in western regions they even came to dominate over truncated blades (Mateiciucová 2002a, 252–53, Graphs 17–18). Similarly, even in the earliest phase of the AVK, end-scrapers are more frequent than truncated blades (Kaczanowska and Kozłowski 1997, 180, 191–92, 204). The truncated blades at Ecsegfalva 23 are very similar to truncated blades of the early phase of the LBK in Transdanubia (Szentgyörgyvölgy-Pityerdomb) and in Lower Austria (Brunn II, Brunn III, Brunn IV) (Mateiciucová 2002a).

Ventral retouched truncated blades

A special variety of truncated blades are truncated blades with ventral retouch. Two ventral retouched truncated blades were found at Ecsegfalva 23 *(Fig. 31.16. 8, 9)*.

Ventral retouched truncated blades occur especially in the south-east part of Central Europe and in the Carpathian basin. They have also been identified at Late Mesolithic sites in Hungary (Jásztelek I),[10] and in the area of the Iron Gates (Lepenski Vir I) (Kozłowski and Kozłowski 1984, pl. 2. 14, 15; Mateiciucová 2002a, 253) as well as Late Mesolithic sites of southern Germany (Jägerhaushöhle 7, Forggensee 2a, Forggensee 6) (Taute 1971, Taf. 19–24, 25; Gehlen 1988, 269, 322). They have also been recognised in the Late Starčevo (Gellénháza-Városrét) and Körös cultures (Battonya), in the Szatmár phase (Méhtelek-Nádas), in the eastern part of Early LBK area (Szentgyörgyvölgy-Pityerdomb, Brunn IIa, Brunn IIb, Brunn IV, Mohelnice, Kladníky) and in the AVK (Zemplínské Kopčany, Zalužice) (Tichý 1962, fig. 9. 11; Bacskay and Siman 1987, pl. I. 3; Kaczanowska 1989, 124; Kozłowski 1989b, pl. II. 21, 25; Starnini 1994a, fig. 9. 20, fig. 12. 4; Kaczanowska and Kozłowski 1997, pl. VI. 27. 7; Mateiciucová 2000; 2002a, 253).

Trapezes and trapeze points

At Ecsegfalva 23 six trapezes were found. Three short trapezes (AZ) were made of obsidian *(Fig. 31.16. 18, 22, 23)* and one of limnic quartzite *(Fig. 31.16. 21)*. Two long trapezes (AA) *(Fig. 31.16. 19, 20)* were from limnic quartzite as well as burned raw material (Kozłowski 1980, 16, figs 28, 29).

Long trapezes are especially typical for the Earliest LBK settlements Brunn IIa and Brunn IIb in Lower Austria (Mateiciucová 2002b, Abb. 1–2). Long trapezes are unknown from Körös sites, except for items associated with the Szatmár phase at Méhtelek-Nádas (Kozłowski 1989b, 396;

Starnini 1994a; Mateiciucová 2002a, 258, 260, tab. 318; 2004, 99). In contrast to this, long trapezes have been identified at Late Mesolithic sites in Transdanubia (Kaposhomok), in northern Hungary (Jásztelek I) and in southern Moravia (Mikulčice, Kůlna 3) (Valoch 1988, Abb. 1. 11; Kertész *et al.* 1994, Taf. III–1; Škrdla *et al.* 1997, Abb. 3. 2, 5; Bánffy 2000a, 175; Marton 2003, Abb. 1. 2–3). Long trapezes were also identified in the Iron Gates, from the pre-Neolithic layers (Vlasac, Lepenski Vir) (Kozłowski and Kozłowski 1982, 96, pl. IX. 17, pl. XXIV. 6; 1984, 270, pl. 4. 10).

For other Körös culture settlements, rather broad trapezes (AC, transverse arrowheads) (Kozłowski 1980, 16, fig. 30) and short trapezes are characteristic (Bacskay and Siman 1987; Kozłowski 1989b, 396; Starnini 1994a; 1994b; Starnini and Szakmány 1998). Short trapezes and broad trapezes (transverse arrowheads) are abundant in the earliest phase of the AVK in east Slovakia as well (Kozłowski 1989b; Kaczanowska and Kozłowski 1997).

The trapezes from Ecsegfalva 23 were always dorsally retouched on one end. The other end was either dorsally retouched only half way, or it was partially dorsally or partially ventrally retouched. Both ways of modification (a half-way retouch or dorsal-ventral retouch) indicate the way in which blades were detached. First, the blade used to make the trapeze was broken off at the required size and then the broken part was partially retouched (half-way retouch, so-called 'Bruch-Technik') (Taute 1973/74). Or secondly, the blade was shortened by retouching a notch and breaking it in the place of the notch ('Kerb-Bruch-Technik') (Taute 1973/74). The broken part could have been left on the trapeze without any further modification (notch fragment), or it could have been retouched once more (dorsal-ventral retouch).

A trapeze point manufactured from limnic quartzite was also found at Ecsegfalva *(Fig. 31.16. 17)*. The occurrence of trapeze points is occasional in the SE part of Central Europe. Similar points are not known from other sites of the Körös culture. One sample was found at the Early LBK site of Brunn IIa (Mateiciucová 2002b, Abb. 1. 14). Trapeze points commonly occur in western Europe and have been identified at mainly Late Mesolithic and Early Neolithic sites (Löhr 1994, Abb. 3–4). Trapeze points found in the Earliest LBK of Bavaria are considered to be relics of regional Late Mesolithic traditions (Schwanfeld) (Gronenborn 1997, 100, Taf. 5.3. 26, 30).[11] However, it is not possible to exclude the possibility that trapeze points originated at Ecsegfalva 23, and possibly also Brunn IIa (Mateiciucová 2002b, Abb. 1. 14), more or less accidentally in relation to the manufacture of long trapezes.

The function of trapezes

Trapezes and blade fragments could have been insert components of spears and harpoons *(Fig. 31.12)*, as indicated by preserved Mesolithic harpoons from the area of the Onega lake in Carelia and Lithuania (Rybakov *et al.* 1989, Tabl. 9. 9, Tabl. 32. 2, 8, 11, 15, Tabl. 33. 28, 35). Fishing played an important role at Ecsegfalva 23. Large fish such as pike, carp and catfish were often sought (see Bartosiewicz, chapter 20), and these kinds of fish can only be caught with a harpoon.

Trapezes also served as arrowheads *(Figs 31.12–13)*. Broad and short trapezes were transversely fixed into the shaft of an arrow (transverse arrowheads and short trapezes), while long and probably also short trapezes were fixed sideways or laterally (composite arrowheads) (Bárta 1989, 458; Hahn 1993, 265; Korobkowa 1999, 101–103; Nuzhnyj 2000, 100, fig. 1).

Bow and arrow were important hunting weapons in the Körös culture. Water birds formed a recurrent item on the menu of the inhabitants of the Ecsegfalva 23 settlement (see Gál, chapter 19). A bow was quite suitable for their hunting. According to ethnographic observation, transverse arrowheads were the most efficient for bird hunting (Piel-Desruisseaux 1990, 157–59). In addition to fishing and water fowl, animal hunting probably also played an important role. Although the faunal remains indicate a low proportion of wild animals, (see Bartosiewicz, chapter 14), it may be that hunting expeditions and the processing of game took place as far away as the foothills, for example of the Tokaj and Zemplén Mountains. Was the procurement of raw stone material (limnic quartzite and Carpathian obsidian) connected with hunting in these areas?

Lateral retouched blades

Two regular lateral retouched blades were identified at Ecsegfalva 23 *(Fig. 31.16. 14)*. One of them is a typical regular blade manufactured from Banat flint *(Fig. 31.11. 14)*. The occurrence of regular lateral retouch is particularly characteristic of large blades (Kozłowski 1982; Kozłowski and Kozłowski 1984; Kaczanowska and Kozłowski 1985; Bacskay and Siman 1987; Paunescu 1987; Kaczanowska 1989). This type of tool is missing in Late Mesolithic horizons of northern Hungary and in pre-Neolithic horizons at the Iron Gates (Kozłowski and Kozłowski 1982; 1984; Kertész *et al.* 1994). At Early LBK settlements, lateral retouched blades appear only very sporadically and are rather atypical (Biró 1987; Gronenborn 1997; Mateiciucová 2002a, 254). Lateral retouched blades are more frequent in the AVK (Kaczanowska and Kozłowski 1997).

Borers and perforators

One thin borer manufactured from limnic quartzite *(Fig. 31.16. 12)* and a borer fragment manufactured from obsidian (*Fig. 31.16. 11)* were attributed to this category. No similar borers, nor perforators with a *weakly* distinguished point, are known from other sites of the Körös culture (Bacskay and Siman 1987; Starnini 1994a; Starnini and Szakmány 1998). It is interesting to note, however, that they do appear in the Neolithic of the Balkans (the Usoye culture and the Dudeşti culture) and also in the LBK of Central Europe (Mateiciucová 2002a, 256). They are considered to be tools surviving from the local Epipaleolithic of the Balkans (Gatsov 1987, 48–49, pl. V; J. K. Kozłowski 1987, 561). They are already known from the Mesolithic of Europe (especially perforators), and are often labelled as a type of 'mèche de forêt' (Heinen 1998, 135).[12]

Burins

One transversal burin and one truncation burin were identified at Ecsegfalva 23. The truncation burin was made from limnic quartzite *(Fig. 31.16. 15)*. The transversal burin was manufactured from obsidian. In this case it is probably a pseudo-burin, which is the result of use-wear of the artefact. But tranversal burins are known from other sites of the Starčevo and Körös cultures as well as the AVK (Gellénháza-Városrét, Endrőd 6, Tiszacsege, Méhtelek-Nádas, Slavkovce, Zemplínské Kopčany) (Starnini 1994b, fig. 5. 10, fig. 25. 1, 2; Starnini and Szakmány 1998, fig. 29. 2). They also regularly appear in the Early LBK (Brunn IIa, Brunn IIb, Neckenmarkt, Mogiła 62, Schwanfeld, Enkingen, Mintraching, Bruchenbrücken and Goddelau) (Kaczanowska *et al.* 1987, pl. I. 12; Kozłowski 1989b, pl. II. 16, pl. V. 5; Gronenborn 1997, Taf. 1. 1–8, 9, Taf. 3. 1–8, 10, Taf. 4. 1–8, Taf. 5. 2–14, 15, Taf. 5. 3–22, Taf. 6. 1–7, 10, Taf. 7. 1–12; Kaczanowska and Kozłowski 1997, pl. VI. 2. 11; Mateiciucová 2002a, 254; 2002b, Abb. 1. 17, Abb. 2. 3, 6, 16–18). Unfortunately, it is not always possible to distinguish whether they were manufactured intentionally or resulted secondarily from use-wear. Transversal burins are also known from the Late Mesolithic of Hungary (Jásztelek I) (Mateiciucová 2002a, 254) and southern Germany (Jägerhaushöhle 7, Forggensee 6) (Taute 1971, Taf. 19. 6; Gehlen 1988, 322).

Splintered pieces

The opinions of researchers are still divided over the classification of splintered pieces, whether as a core or as a tool *(Fig. 31.14. 16)*. Splintered pieces are distinguished by impact scars on two or more opposite ends, and from them spreading flake negatives (scars). Their function was probably different in different places and in different periods. Most often it is thought that they were used as so-called chisels (Małecka-Kukawka 2001, 139). Sometimes their function is also considered as a punch in blade production (Migal 1987; Hahn 1993, 249–50). In areas with a lack of the raw material or where the material occurred only in the form of small-size nuggets (and nodules), it is thought that they had the role of cores and served for the production of small flakes (Kaczanowska 1987, 176; Małecka-Kukawka 1992, 29).

Analysis of the LBK chipped stone industry of Lower Austria and Moravia confirmed that these artefacts more often occur on settlements which were obtaining raw stone material from distant sources. On the contrary, on settlements near raw stone material sources, splintered pieces are nearly absent (Mateiciucová 2002a, 40–41, 263). I suggest that their presence is especially related to restricted or irregular supply of the material and that splintered pieces therefore served as cores for the production of small sharp flakes. This is in contrast to the conclusions reached by Małecka-Kukawka (2001, 139–42). By examining traces of use-wear on chipped stone artefacts from the LBK of Chełmno-land in northern Poland, she concluded that all splintered pieces were used as chisels in woodworking. It may be that an exact distinction between a splintered piece-tool and a splintered piece-core is not possible, and that both functions (the function of a tool and the function of a core) mostly overlap. Small sharp flakes, so called 'flakes for one use', could have been made from disused cores by the splinter technique. The form of some of them may suggest use as a chisel.

At Ecsegfalva 23 three artefacts from limnic quartzite were classified as splintered pieces. Splintered pieces are not known from other Körös culture sites. However, it is possible that splintered pieces were found at other Körös culture sites, but have not recognised as such.

Hammerstones

Two hammerstones were found at Ecsegfalva 23. They may have served either for the production of chipped stone artefacts or for activities connected with grinding and knapping. One hammerstone was made from a quartz pebble, and the second was preserved only as a fragment of burnt material.

Traces of use on unretouched blades

Visible traces of use on unretouched blades indicate that they were also used as tools, for example as knives. Traces of use were most often identified on obsidian blades *(Table 31.26)*. On the other hand, traces of use are rare on limnic quartzite blades. This difference may be due to the quality of the raw stone material, although it is noteworthy that it is rare to find traces of use on limnic quartzite flakes as well as obsidian flakes *(Table 31.25)*.

Differences in the degree of utilisation of these artefacts may also be interpreted as indications of intervals in which the materials arrived at the settlement, which would mean that obsidian was supplied at a different time to limnic quartzite. Obsidian was probably procured sooner, indicated by the occurrence of quite exhausted cores, more utilised blades and a higher propor-

Table 31.25. Ecsegfalva 23B and 23C, Körös culture. Macroscopic visible use traces on flakes and flake tools

Use traces on flakes	No. of pieces	%	Obsidian	%	Limnic quartzite	%
One edge	8	5.1	4	???	3	2.8
Both edges	1	0.6	0	???	1	0.9
Yes – but unspecific	7	4.5	2	???	5	4.7
Without	82	52.6	12	???	65	61.3
Indeterminate	58	37.2	18	???	32	30.2
Total	**156**	**100**	**36**	???	**106**	**99**.9

Table 31.26. Ecsegfalva 23B and 23C, Körös culture. Macroscopic visible use traces on blades and blade tools

Use traces on blades	No. of pieces	%	Obsidian	%	Limnic quartzite	%
One edge	38	25	17	27.4	18	21.4
Both edges	27	17.8	20	32.3	5	6
Yes – but unspecific	4	2.6	2	3.2	2	2.4
Without	78	51.3	22	35.5	56	66.7
Indeterminate	5	3.3	1	1.6	3	3.6
Total	**152**	**100**	**62**	**100**	**84**	**100**.1

tion of obsidian tools. Limnic quartzite was therefore probably procured later than obsidian. Precores or initial cores manufactured from limnic quartzite were also found in the settlement.

The limited spectrum of tool types and the heavy use of blades at Ecsegfalva 23 indicate that unretouched blades were most often used as tools. Use-wear analysis also confirms this (see Małecka-Kukawka, below). Furthermore, retouched tools also show evidence of use on unretouched sides. This means that retouch mainly served to modify the form of the artefact to enable easier fixing into hafts or handles. On most Körös culture settlements, large blades appear, often with lateral retouch. These robust blades served as multi-functional tools (Starnini and Szakmány 1998, 282–83). They were apparently more durable than small narrow blades, and one large robust blade lasted as long as several small blades.

Sickle gloss and gloss of other origin

Altogether nine fragments of blades with gloss were identified *(Table 31.27)*. Two blades were produced from obsidian and the others from limnic quartzite. All fragments are small and only one was retouched. Unretouched sickle blades have also been identified at other Körös sites and are also typical for the Early LBK (Bacskay and Siman 1987; Gronenborn 1997; Starnini and Szakmány 1998; Mateiciucová 2002a).

Only three out of the artefacts with gloss can be identified as sickles. Use-wear analysis confirmed that gloss originated more often from cutting soft plants (grass and green reed?) than only grain (see Małecka-Kukawka, below) (Hahn 1993, 278; Korobkowa 1999, 126–38). Gloss on the other six artefacts is little visible and may have originated from their use as knives for cutting fish or skin (Korobkowa 1999, 119–25). Atypical dull gloss was found on two obsidian artefacts and may be related to cutting grass or to sawing bones and wood. Małecka-Kukawka found traces of use related to the cutting of soft plants on other artefacts (see below).

Table 31.27. Ecsegfalva 23B and 23C, Körös culture. Single gloss and other glosses on the artefacts

No.	Raw material	Type of blanks	Tool	Remarks	After use-wear analysis (J. Małecka-Kukawka)	
					Motion	Contact-material
1	Carpathian obsidian I	Blade with broken terminal part	no	gloss almost undistinct	unanalysed	
2	Carpathian obsidian I	Mesial fragment of blade	yes	gloss almost undistinct	1. sawing, 2. scraping	wood/bone/antler
3	Limnic quartzite	Blade with broken terminal part	no		cutting	cereals
4	Limnic quartzite	Mesial fragment of blade	no		cutting	soft plants
5	Limnic quartzite?	Mesial fragment of blade	no	gloss tight along the edge	unanalysed	
6	Limnic quartzite?	Blade with broken terminal and basal parts	no	gloss tight along the edge	cutting	dry hide
7	Mezőzombor limnic quartzite	Blade with broken terminal part	no	gloss almost undistinct	unanalysed	
8	Mezőzombor limnic quartzite	Basal fragment of blade	no	gloss tight along the edge	unanalysed	
9	Mezőzombor limnic quartzite ?	Blade with broken basal part	no		cutting + hafting	soft plants

The technique of blade production and comparisons with other regions and the Mesolithic period

At Ecsegfalva 23 small and narrow blades are typical *(Fig. 31.15)*. Small and narrow blades similar to those at Ecsegfalva 23 are typical for the Early LBK in Transdanubia, as well as other parts of Central Europe (Mateiciucová 2002a, 245–46; 2002b, 172–73; 2004). Small blades have also been identified on some other Körös (Bacskay and Siman 1987) and Late Starčevo sites (Gellénháza, Vörs-Máriaasszony-sziget) (Kalicz *et al.* 1998, 163–68). However, rather large and long blades are characteristic for the Körös culture. These were most frequently manufactured from Banat flint. Although long obsidian and limnic quarzite blades were no exceptions (Dévaványa 26, Dévaványa 6, Hódmezővásárhely-Kotacpart, Furta-Csátó, Méhtelek-Nádas) (Bacskay and Siman 1987, 118–22; Starnini 1994a; Starnini and Szakmány 1998). Likewise, long and large blades manufactured from Banat flint predominate in the Starčevo culture (Kozłowski and Kozłowski 1984, 274–75; Kaczanowska and Kozłowski 1985; J. K. Kozłowski 1987, 561). It seems that the production of the large blades is closely connected with this raw stone material. It appears that Banat flint occurred in large blocks or nodules, which made the production of long blades possible.

At Ecsegfalva 23, only one comparable example of a large blade was found: a laterally retouched blade fragment manufactured from Banat flint *(Fig. 31.11. 14)*.[13]

It has been suggested that large regular blades of the Körös and Starčevo cultures were manufactured with the pressure technique (Kozłowski and Kozłowski 1984, 274–75; Kaczanowska and Kozłowski 1985; J. K. Kozłowski 1987, 561; Kaczanowska 1989; Ginter and Kozłowski 1990, 64).[14] The pressure technique was already known since the Epipalaeolithic and Late Mesolithic in the Near East, Central Asia, the Mediterranean and the Pontic area. In some areas, this tradition continued to be practised into the Early Neolithic (S. K. Kozłowski 1987, 9, 10; Perlès 1987, 23, 28; Kozłowski 1989a; Domańska 1990b; Gronenborn 1997, 83, 84).

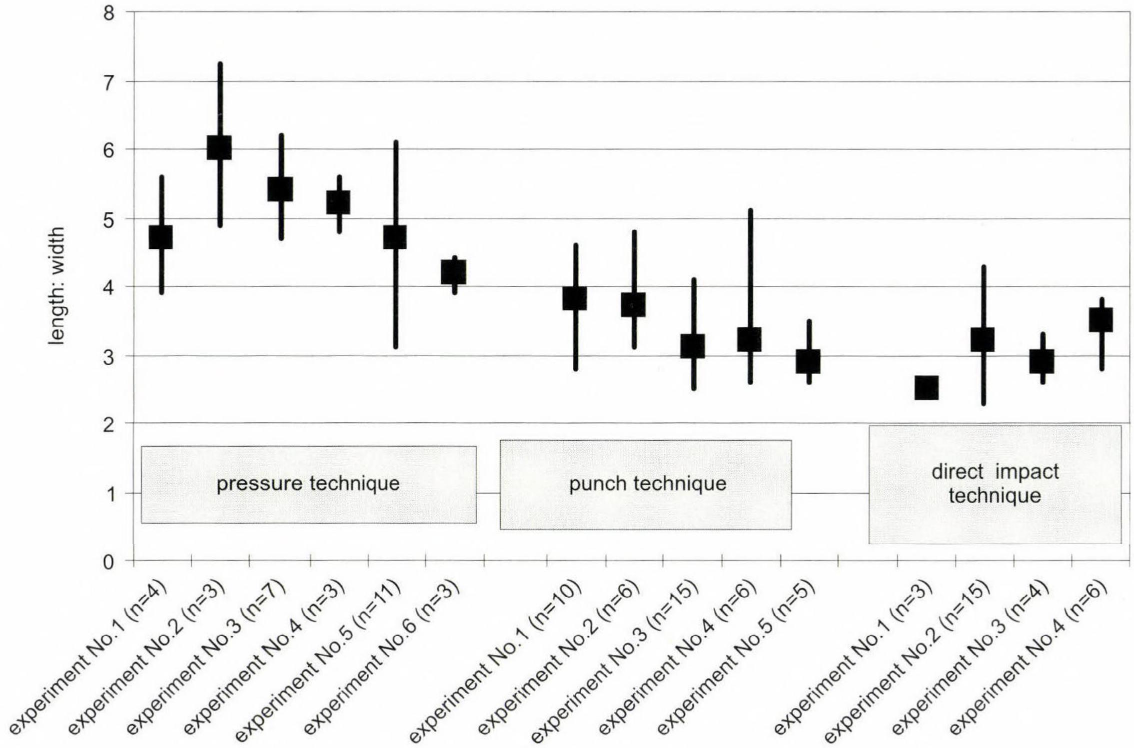


Fig. 31.3. Length/width indices of experimentally manufactured blades

But how were the small and narrow blades manufactured at Ecsegfalva 23 and other Körös and Starčevo culture sites? Very similar blades are also characteristic for the LBK, especially its earlier phase and the earlier phase of the AVK (Kozłowski 1989a; Kaczanowska and Kozłowski 1997; Mateiciucová 2002a, 239–46).

The use of experiment

Three basic techniques of blade production are known: by direct impact; by punch; and by pressure. In an attempt to become more familiar with the techniques of blade production used in the Early Neolithic period, and in order to distinguish each technique, I gathered together the characteristics of each type as specified by the literature and experimentally made blades. Over the past five years, W. Migal, of the State Archaeological Museum in Warsaw, has produced experimental blades using different techniques and materials (such as flint and radiolarite). These experiments formed the basis of the criteria used to identify the technique of blade production (Mateiciucová 2002a, 236; 2003, 301–305; 2004), especially when differentiating between blade production by the punch technique and the pressure technique, which can be quite difficult. I tried to define criteria according to which it would be possible to graphically compare a larger amount of blades. I also looked for a way to compare blades from my own studies with blades published in drawings or data in the literature. The problem is that not every author is interested in the same features of the blades, although nearly everyone cites the basic measurements of the artefacts. Furthermore, if these data are not immediately available, they can be deduced from drawings. Comparisons of length, width and thickness were important distinguishing criteria for blades produced by pressure and punch technique. First, I created indices of the ratio of length and width *(Fig. 31.3)* and the ratio of length, width and thickness *(Fig. 31.4)* for the experimentally made blades. Index

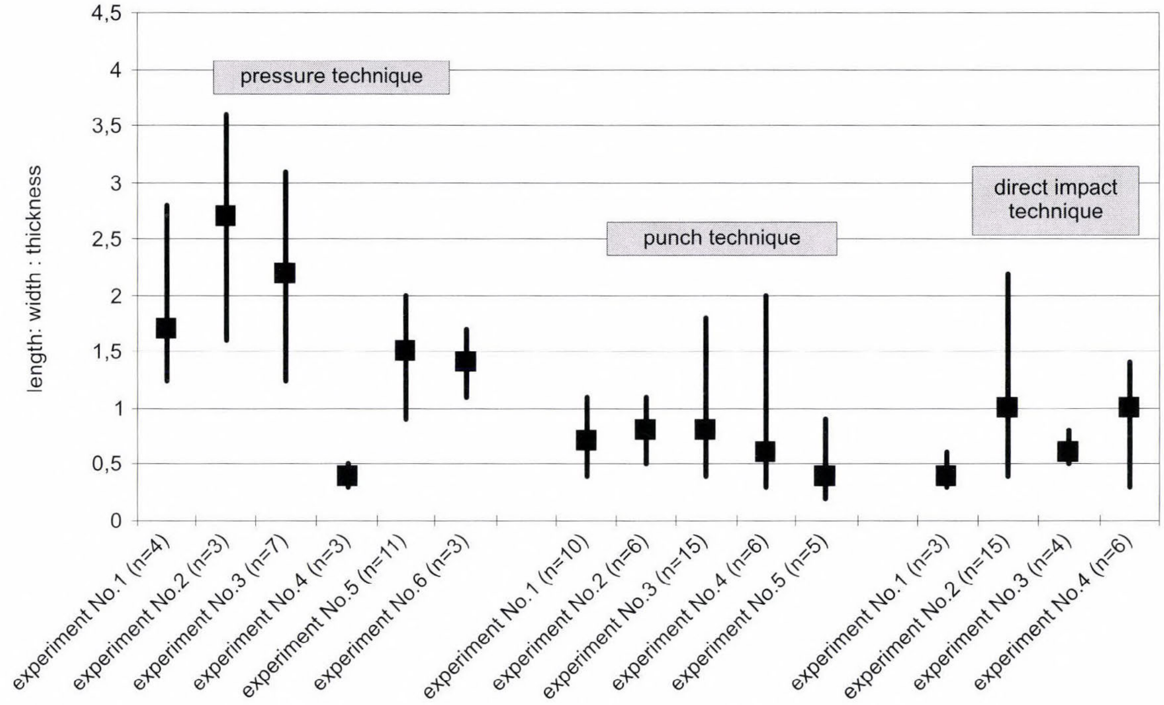


Fig. 31.4. Length/ width/thickness indices of experimentally manufactured blades

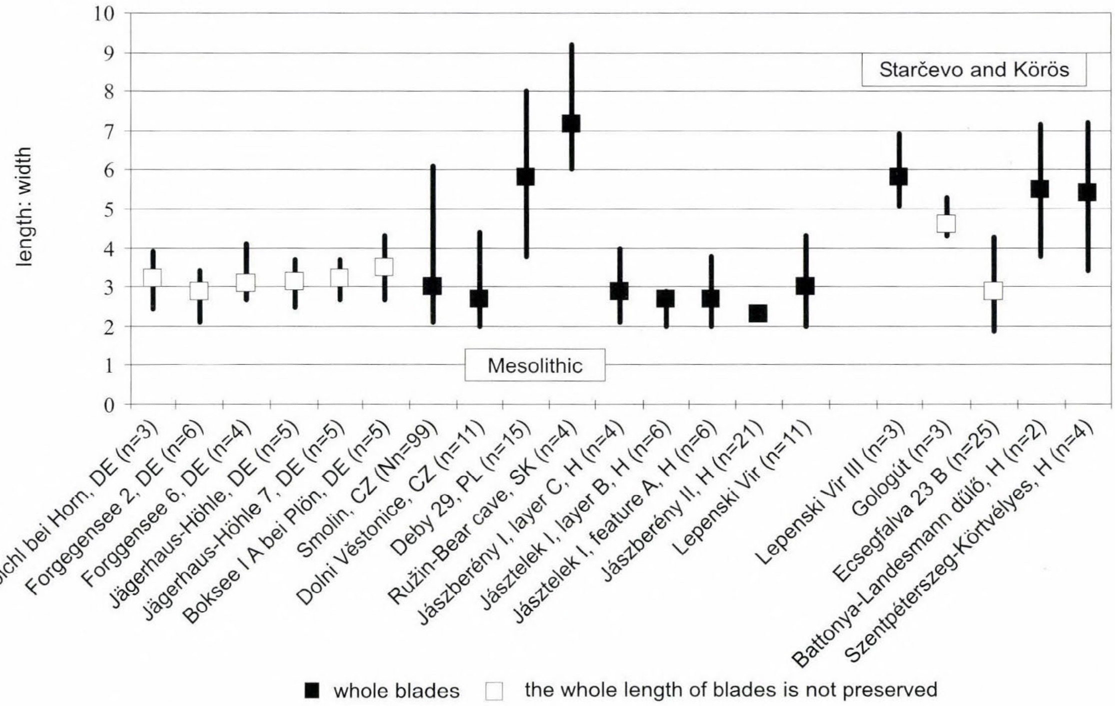


Fig. 31.5. Length/width indices of blades from Mesolithic, Starčevo and Körös sites

values are markedly higher for blades made by pressure (indices length/width fall between 4–6, and length/width/thickness between 1–3) than for blades made by the punch or direct impact technique, for which the index values are similar (length/width falls between 2–4 and length/width/thickness is less than 1).[15]

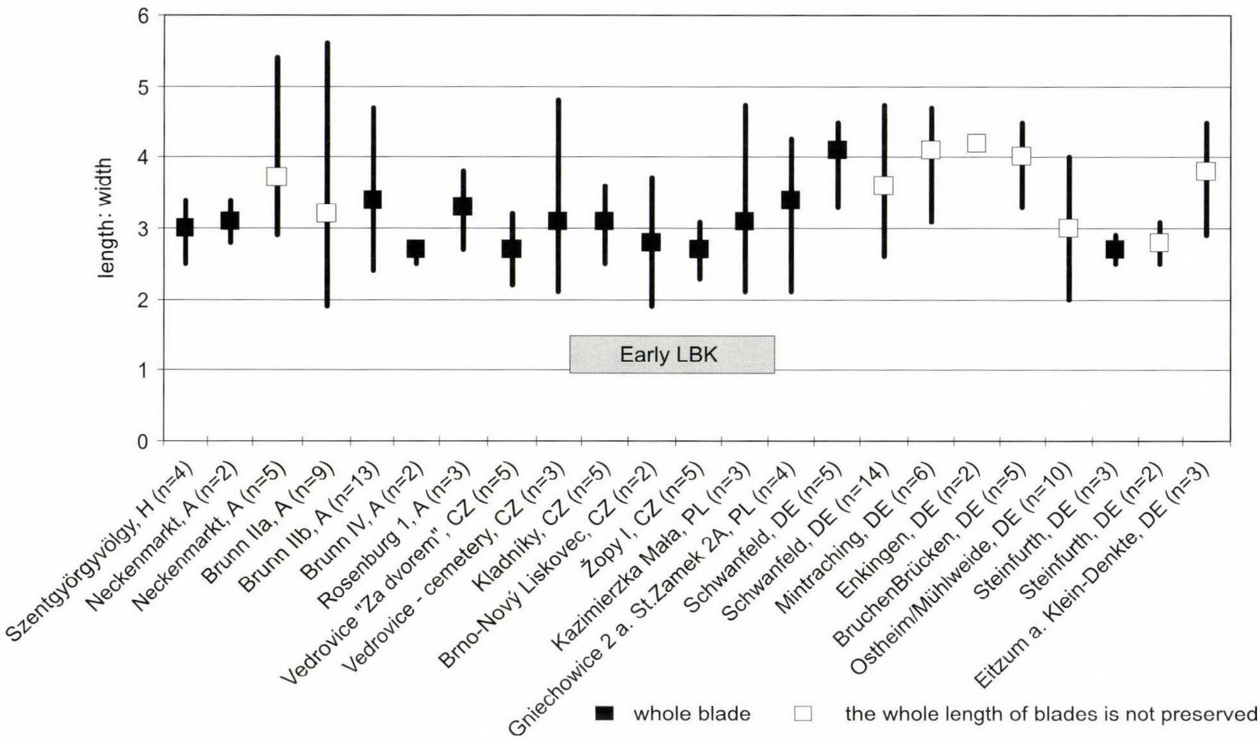


Fig. 31.6. Length/width indices of blades from Early LBK sites

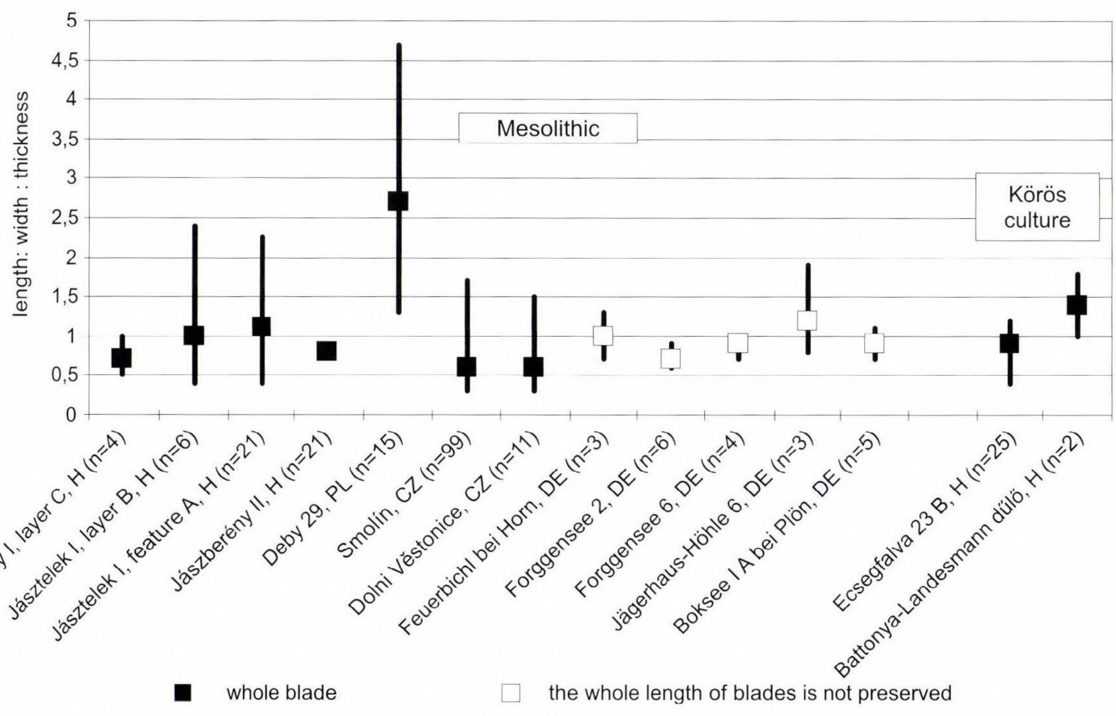


Fig. 31.7. Length/width/thickness indices of blades from Mesolithic and Körös sites

After that I compared the index values of experimentally made blades with the index values of blades from Ecsegfalva 23 and from other sites of the Körös, Starčevo and LBK cultures and from Late Mesolithic sites *(Figs 31.5–8)*. The index values of large robust blades of the Körös

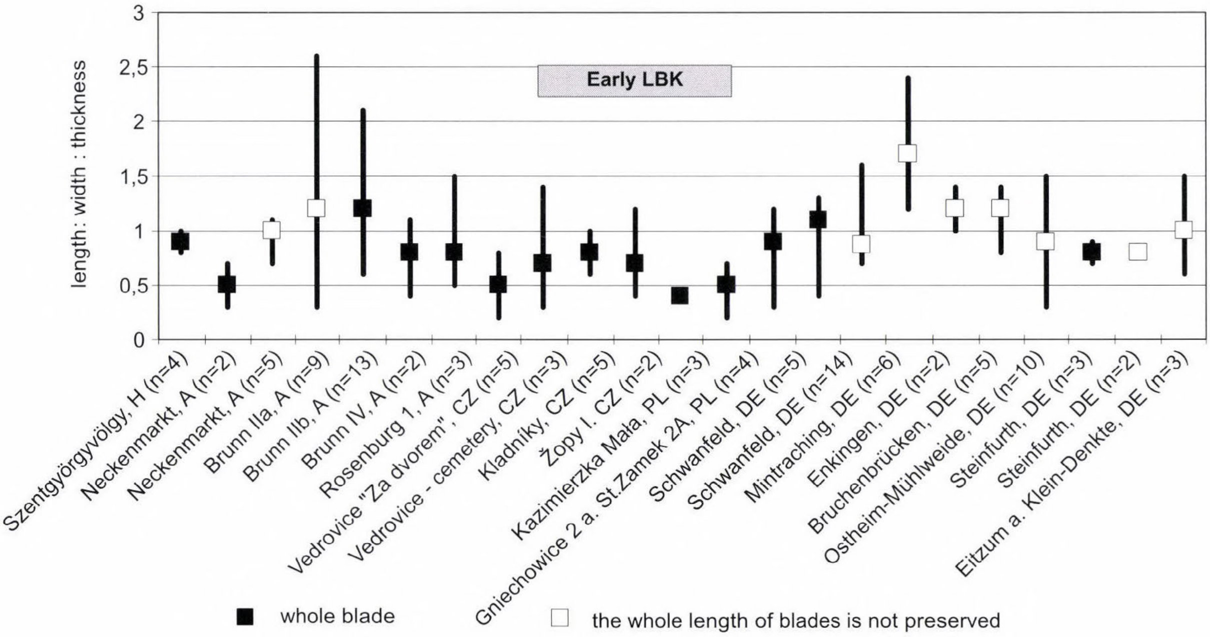


Fig. 31.8. Length/width/thickness indices of blades from Early LBK sites

and Starčevo cultures are similar to the index values of experimentally made blades by pressure. However, the blades from Ecsegfalva 23 and blades from most sites of the LBK culture are similar with the index values of blades produced by either the punch technique or direct impact. One of the basic criteria for distinguishing between blades produced by the punch technique or direct impact (from single platform core) is the platform remnant angle *(Table 31.21)*. Blades produced by direct impact most often indicate an acute angle (< 80°) by the platform remnant and dorsal side. On the contrary, the platform remnant angle of blades produced by the punch technique falls between 85°–95°. Considering the striking angles of the cores and blades in addition to all of the other criteria, I came to the conclusion that small blades at Ecsegfalva 23 and in the Early LBK were made by the punch technique (Mateiciucová 2002a, 233–40; 2004, 93).

From where, however, does the punch technique originate?
Does it originate from a local Mesolithic tradition?

Sadly there are very few Mesolithic sites in south-eastern Central Europe which can be designated as Late Mesolithic.[16] The blades manufactured at these sites were primarily irregular blades, made using the direct impact technique. The production of regular blades was also observed, however, at some sites (Dolní Věstonice, Jásztelek I, Jászberény II, Jászberény III);[17] the production method is reminiscent of the punch technique (Mateiciucová 2002a, 243).

During the Late Mesolithic, apart from the emergence of trapezes, one can observe a tendency towards the production of regular blades nearly in all regions of southern Europe. Researchers formerly viewed this as the general tendency towards regular blade production associated with developments in the Mediterranean area and the Near East (Taute 1973/74, 76; S. K. Kozłowski 1987; Gronenborn 1997).

The phenomenon of *the regular blade* which continued to develop especially in the Neolithic, does not, however, refer to the same phenomena in all regions, as it was previously assumed. Regular blades from the Mediterranean area differ from those of south-east Central Europe.

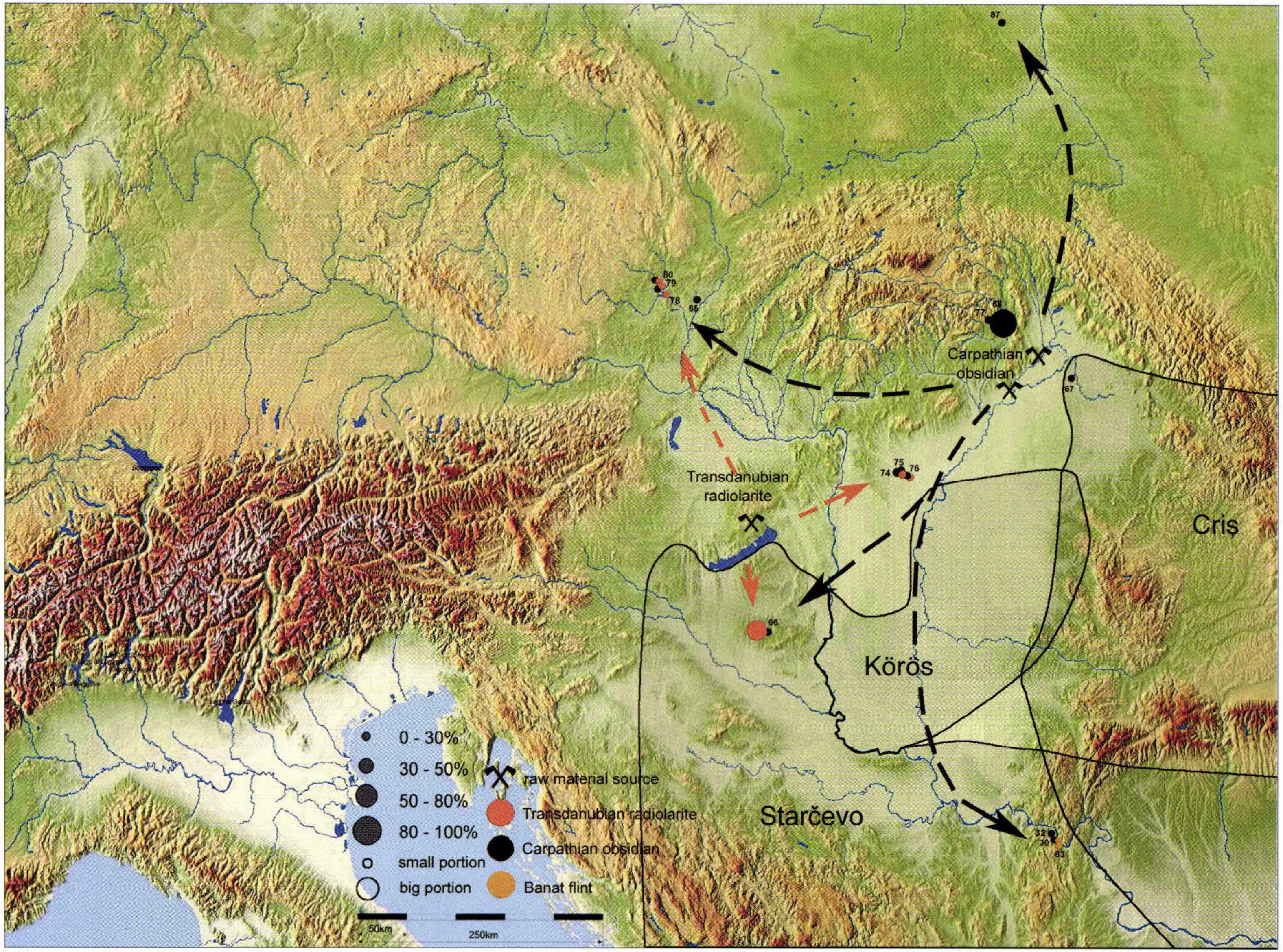


Fig. 31.9. Distribution of Transdanubian radiolarite, Carpathian obsidian and Banat flint during the Mesolithic period. For site listing, see *Table 31.28*

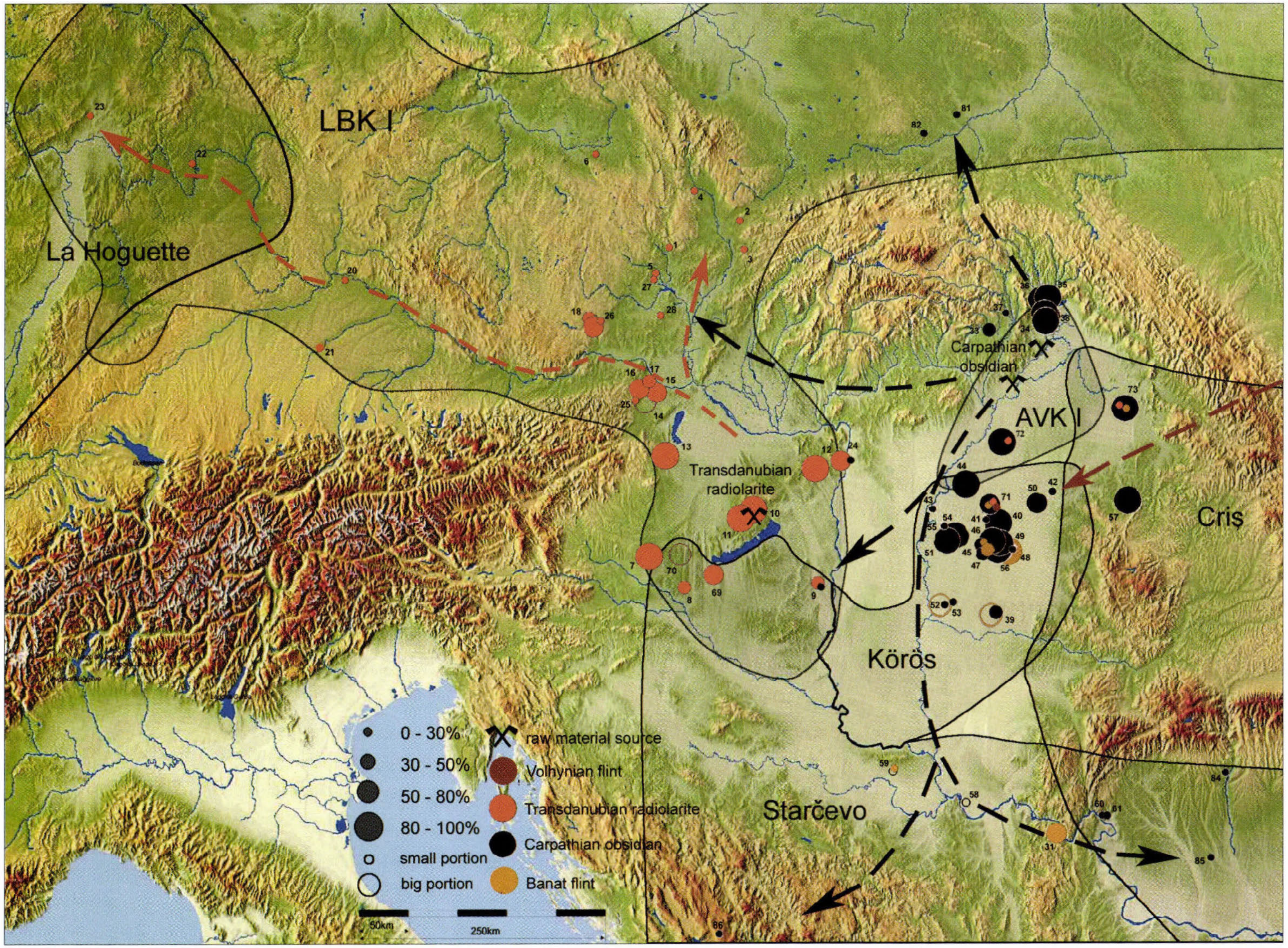


Fig. 31.10. Distribution of Transdanubian radiolarite, Carpathian obsidian and Banat and Volhynian flint during the Early Neolithic period. For site listing, see *Table 31.28*

Table 31.28. List of sites corresponding with *Figs 31.9–10*

No.	Site	Country	Period	Reference
1	Brno-Ivanovice	Czech Rep.	LBK I	own study
2	Kladníky	Czech Rep.	LBK I	own study
3	Žopy I	Czech Rep.	LBK I	own study
4	Mohelnice	Czech Rep.	LBK I	Gronenborn 1997, 110
5	Vedrovice *Za* dvorem	Czech Rep.	LBK I	own study
6	Bylany I	Czech Rep.	LBK I	Lech 1989, 112
7	Szentgyörgyvölgy-Pityerdomb	Hungary	LBK I	own study
8	Rigyác	Hungary	LBK I	Biró 1987, 131–67, 145
9	Szentlőrinc-Téglagyár	Hungary	LBK I	Biró 1987, 131–67, 145
10	Veszprém- Nándortelep	Hungary	LBK I	Biró 1987, 131–67, 146; 1998, 48
11	Hidegkút	Hungary	LBK I	Biró 1987, 131–67, 145
12	Bicske-Galagonyás	Hungary	LBK I	Biró 1998, 59, 251
13	Neckenmarkt	Austria	LBK I	Gronenborn 1997, 20
14	Perchtoldsdorf	Austria	LBK I	Gronenborn 1997, 108
15	Brunn IIa	Austria	LBK I	own study
16	Brunn IIb	Austria	LBK I	own study
17	Brunn IV	Austria	LBK I	own study
18	Strögen	Austria	LBK I	Gronenborn 1997, 24
19	Rosenburg I	Austria	LBK I	own study
20	Mintraching	Germany	LBK I	Gronenborn 1997, 26
21	Langenbach	Germany	LBK I	Tillmann 1993
22	Schwanfeld	Germany	LBK I	Gronenborn 1997, 34
23	Ostheim-Mühlweide	Germany	LBK I	own study
24	Budapest-Aranyhegyi út	Hungary	LBK I	Biró 1998, 46, 145–46
25	Brunn I	Austria	LBK I/II	own study
26	Mold	Austria	LBK I/II	own study
27	Vedrovice Široká u lesa cemetery	Czech Rep.	LBK I/II	Mateiciucová 2002d
28	Kleinhadersdorf cemetery	Austria	LBK I/II	own study
30	Lepenski Vir I	Serbia	Pre-Neolithic I	Kozłowski and Kozłowski 1984, 261
31	Lepenski Vir III	Serbia	Starčevo	Kozłowski and Kozłowski 1984, 271
32	Padina A1	Serbia	Mesolithic	Gronenborn 1997, 106
33	Čečejovce	Slovakia	Eastern LBK I	Kozłowski 1989b, 390
34	Zemplínské Kopèany	Slovakia	Eastern LBK I	Kozłowski 1989b, 391
35	Zalužice – 1/91+1,2/94	Slovakia	Eastern LBK I/II	Kaczanowska and Kozłowski 1997, 184–92
36	Zbudza	Slovakia	Eastern LBK I/II	Kaczanowska and Kozłowski 1997, 192–210
37	Košice-Barca	Slovakia	Eastern LBK I	Kaczanowska 1985, 47
38	Slavkovce D-F 1988	Slovakia	Eastern LBK I	Kaczanowska and Kozłowski 1997, 177–184
39	Battonya-Landesman dűlő	Hungary	Körös	Bacskay and Siman 1987, 117
40	Dévaványa 26	Hungary	Körös	Bacskay and Siman 1987, 121–22
41	Dévaványa 6	Hungary	Körös	Bacskay and Siman 1987, 120–21
42	Szentpéterszeg- Körtvélyes	Hungary	Körös	Bacskay and Siman 1987, 123
43	Szolnok-Szanda, Tenyősziget	Hungary	Körös	Bacskay and Siman 1987, 124–25
44	Tiszagyenda-Garahalom	Hungary	Körös	Bacskay and Siman 1987, 125

Table 31.28. Continued

No.	Site	Country	Period	Reference
45	Endrőd 119	Hungary	Körös	Starnini and Szakmány 1998, Tab.1
46	Endrőd 23	Hungary	Körös	Starnini and Szakmány 1998, Tab.3
47	Endrőd 35	Hungary	Körös	Starnini and Szakmány 1998, Tab.4
48	Endrőd 39	Hungary	Körös	Kaczanowska *et al.* 1981; Starnini and Szakmány 1998, Tab.2
49	Endrőd 36	Hungary	Körös	Bacskay and Siman 1987, 120
50	Furta-Csátó	Hungary	Körös	Bacskay and Siman 1987, 122
51	Gyoma 51	Hungary	Körös	Bacskay and Siman 1987, 120
52	Hódmezővásárhely-Bodzáspart	Hungary	Körös	Bacskay and Siman 1987, 117–18
53	Hódmezővásárhely- Kotacpart	Hungary	Körös	Bacskay and Siman 1987, 118–19
54	Szarvas 23	Hungary	Körös	Bacskay and Siman 1987, 119
55	Szarvas 8	Hungary	Körös	Bacskay and Siman 1987, 120
56	Endrőd 6- Kápolnahalom	Hungary	Körös and AVK	Starnini and Szakmány 1998, Tab.5
57	Gura Baicului	Rumania	Proto-Starč.-Criş	Willms 1982;Gronenborn 1997, 106
58	Starčevo	Serbia	Starčevo	Willms 1982; Gronenborn 1997, 106
59	Golokut	Serbia	Starčevo	Kozłowski and Kozłowski 1984, 275; Kaczanowska and Kozłowski 1985, 27
60	Ostrovul Banului	Rumania	Starčevo-Criş	Willms 1982; Gronenborn 1997, 106
61	Schela Cladovei	Rumania	Starčevo-Criş	Willms 1982; Gronenborn 1997, 107
62	Tomášikovo	Slovakia	Mesolithic	Mateiciucová 2001
63	Bratislava	Slovakia	Mesolithic	Mateiciucová 2001
64	Sereï	Slovakia	Mesolithic	Mateiciucová 2001
65	Mikulčice	Czech Rep.	Mesolithic	Škrdla *et al.* 1997
66	Kaposhomok	Hungary	Mesolithic	Kertész 1993, 89; Marton 2003
67	Tarpa-Márki tanya	Hungary	Mesolithic	Kertész 1993, 90
68	Košice-Barca I	Slovakia	Mesolithic	Bárta 1965, 162, 199
69	Vörs-Máriaasszony-sziget	Hungary	Starčevo	Kalicz *et al.* 1998, 181
70	Gellénháza-Városrét	Hungary	Starčevo	Biró 2002
71	Ecsegfalva 23	Hungary	Körös	own study
72	Tiszacsege-Homokbánya	Hungary	Körös	Starnini 1994b, 103
73	Méhtelek-Nádas	Hungary	Körös	Starnini 1994a, 29–96
74	Jászberény II	Hungary	Mesolithic	Kertész *et al.* 1994, 29; Mateiciucová 2002b
75	Jászberény III	Hungary	Mesolithic	own study
76	Jásztelek I	Hungary	Mesolithic	Kertész *et al.* 1994; own study
77	Ružín Bear cave (Medvedia cave)	Slovakia	Mesolithic	Bárta 1990
78	Dolní Věstonice 'Písky'	Czech Rep.	Mesolithic	Mateiciucová 2001
79	Pøibice	Czech Rep.	Mesolithic	Mateiciucová 2001
80	Smolín	Czech Rep.	Mesolithic	Mateiciucová 2001
81	Kazimierza Mała 1	Poland	LBK I	own study
82	Kraków-Mogiła 62	Poland	LBK I	Kaczanowska and Lech 1977, 9
83	Vlasac I–III	Serbia	Mesolithic	Kozłowski and Kozłowski 1984, Tab. II
84	Velea Raii Vilcea	Romania	Starčevo-Criş	Willms 1982; Gronenborn 1997, 106
85	Balş	Romania	Starčevo-Criş	Willms 1982; Gronenborn 1997, 106
86	Obre IA–ID	Bosnia and Herzegovina	Starčevo	Willms 1982; Gronenborn 1997, 107
87	Grzybowa Góra-'Rydno' XIII/59	Poland	Mesolithic	Cyrek 1981, 43

Fig. 31.11. Ecsegfalva 23, Körös culture. Chipped stone artefacts. 1–13, 18, 19: limnic quartzites, 7–8: Mezőzombor limnic quartzites, 14, 16: Banat flint, 15: Szentgál radiolarite, 17, 20–31: Carpathian obsidian I

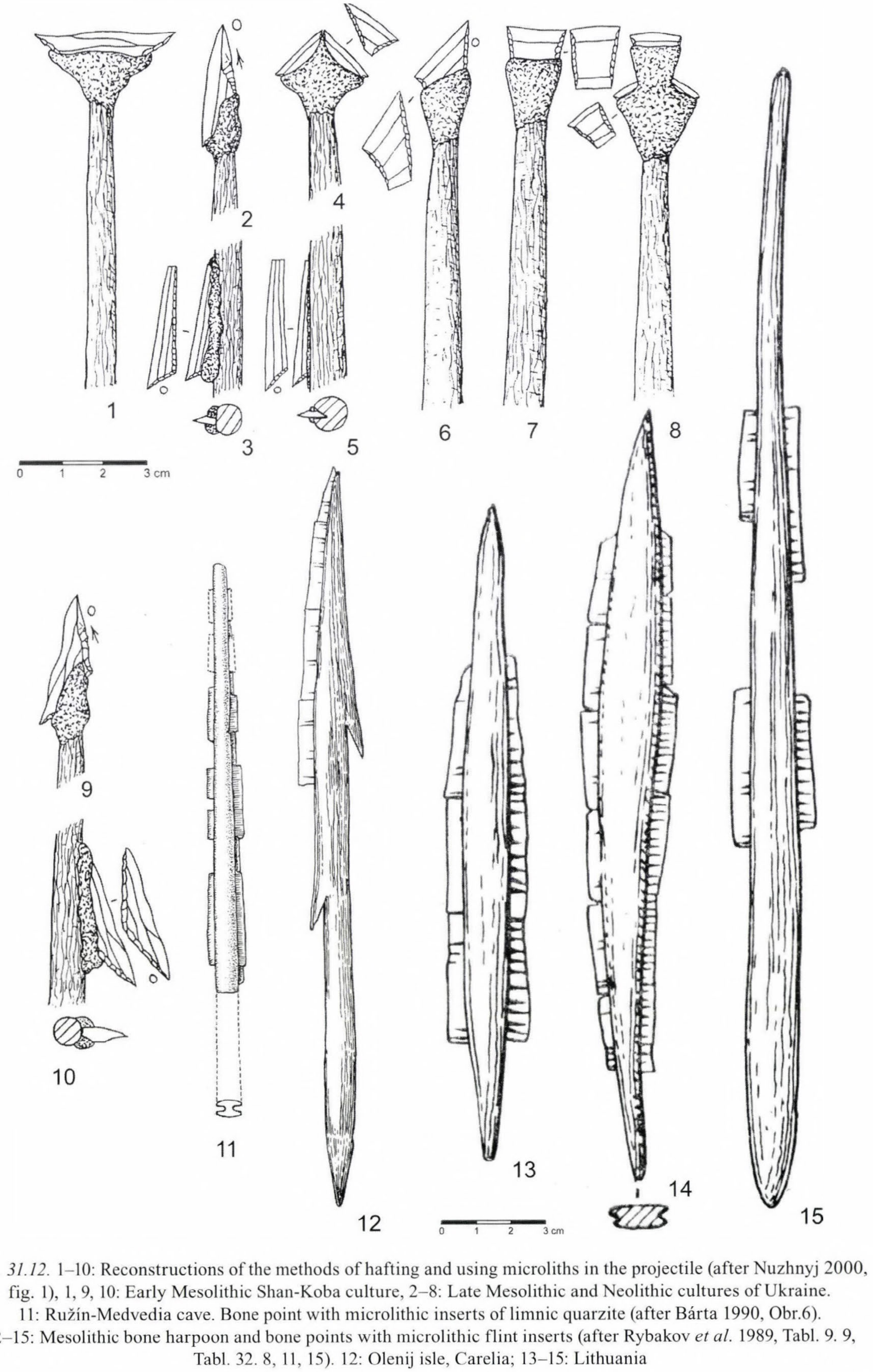


Fig. 31.12. 1–10: Reconstructions of the methods of hafting and using microliths in the projectile (after Nuzhnyj 2000, fig. 1), 1, 9, 10: Early Mesolithic Shan-Koba culture, 2–8: Late Mesolithic and Neolithic cultures of Ukraine. 11: Ružín-Medvedia cave. Bone point with microlithic inserts of limnic quarzite (after Bárta 1990, Obr.6). 12–15: Mesolithic bone harpoon and bone points with microlithic flint inserts (after Rybakov *et al.* 1989, Tabl. 9. 9, Tabl. 32. 8, 11, 15). 12: Olenij isle, Carelia; 13–15: Lithuania

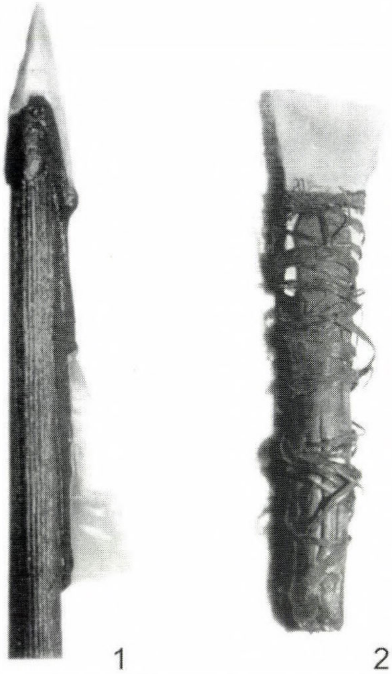


Fig. 31.13. 1: Mesolithic arrow with microlithic flint inserts from Lilla Loshult, University Museum Lund, Sweden; 2: Mesolithic transverse arrowhead, National Museum Copenhagen, Denmark (after Junkmanns 2001, Abb. 4, Abb. 6)

In the Mediterranean area, regular blades were manufactured primarily with the pressure technique. In contrast to this, characteristics of blades from south-east Central Europe are more suggestive of the punch technique (Mateiciucová 2002a, 242–47). Characteristics of small and narrow blades from Early LBK settlements also indicate the use of the punch technique. One can assume that the same technique was also used at Ecsegfalva 23, at other Körös culture settlements, and Late Starčevo culture sites.

Based on these observations, we can accept that we are dealing with two different production techniques in the Körös culture, which could correspond to two different traditions (J. K. Kozłowski 1987, 561; Kaczanowska 1989; Kalicz *et al.* 1998, 165; Mateiciucová 2002a, 245–47; 2003, 305).

The first, the pressure technique, has been known from the Mediterranean area since the Late Mesolithic (S. K. Kozłowski 1987; Perlès 1987; Kozłowski 1989a). This technique continued to be used during the Balkan Neolithic at Starčevo and Körös culture settlements. As the pressure technique seems to have originated in the Near East during the Epipaleolithic and then spread up through the Mediterranean and the Balkans during the Late Mesolithic and the Early Neolithic, I have termed it the 'Mediterranean tradition'.

The second, the punch technique, spread primarily through southern Central Europe and has been identified at Earliest LBK sites, and was also partially employed at some Körös and Late Starčevo culture sites. Whether it was also used in other areas of the Balkans is a question for further research. I have termed this the 'Danubian tradition'.

The 'Danubian tradition' has roots in the local Late Mesolithic of south-eastern Central Europe and was practised further by Early Neolithic communities in Central Europe. Late Mesolithic communities developed the punch technique as their answer to changes in the Mediterranean area. It became their way of producing the Mediterranean style regular blades, using the punch technique rather than the pressure technique. I call this adaptation 'variation on the Mediterranean tradition'.

In areas where use of the punch technique has been confirmed, relations between regions were ongoing since the Mesolithic, based on the circulation of raw stone materials, particularly Szentgál radiolarite *(Fig. 31.9)* (Mateiciucová 2002a, 284). These were recognised in northern Hungary in the Late Mesolithic layers of Jásztelek I, Jászberény II, Jászberény III and were also found on southern Moravian Mesolithic sites (Smolín, Přibice, Dolní Věstonice) (Mateiciucová 2001, Tab. I, II, V; 2002a, 284). The distribution of Transdanubian radiolarites in Slovakia has not yet been studied in detail.

In the Early Neolithic, Late Starčevo communities that settled south of Lake Balaton, used Szentgál radiolarite in great quantities (Biró 2002, 122–23). A few samples of Szentgál radiolarite have also been identified at the Ecsegfalva 23 Körös culture settlement and at settlements of the Szatmár phase (Méhtelek-Nádas, Tiszacsege-Homokbánya) (Starnini 1994b, 102–03).

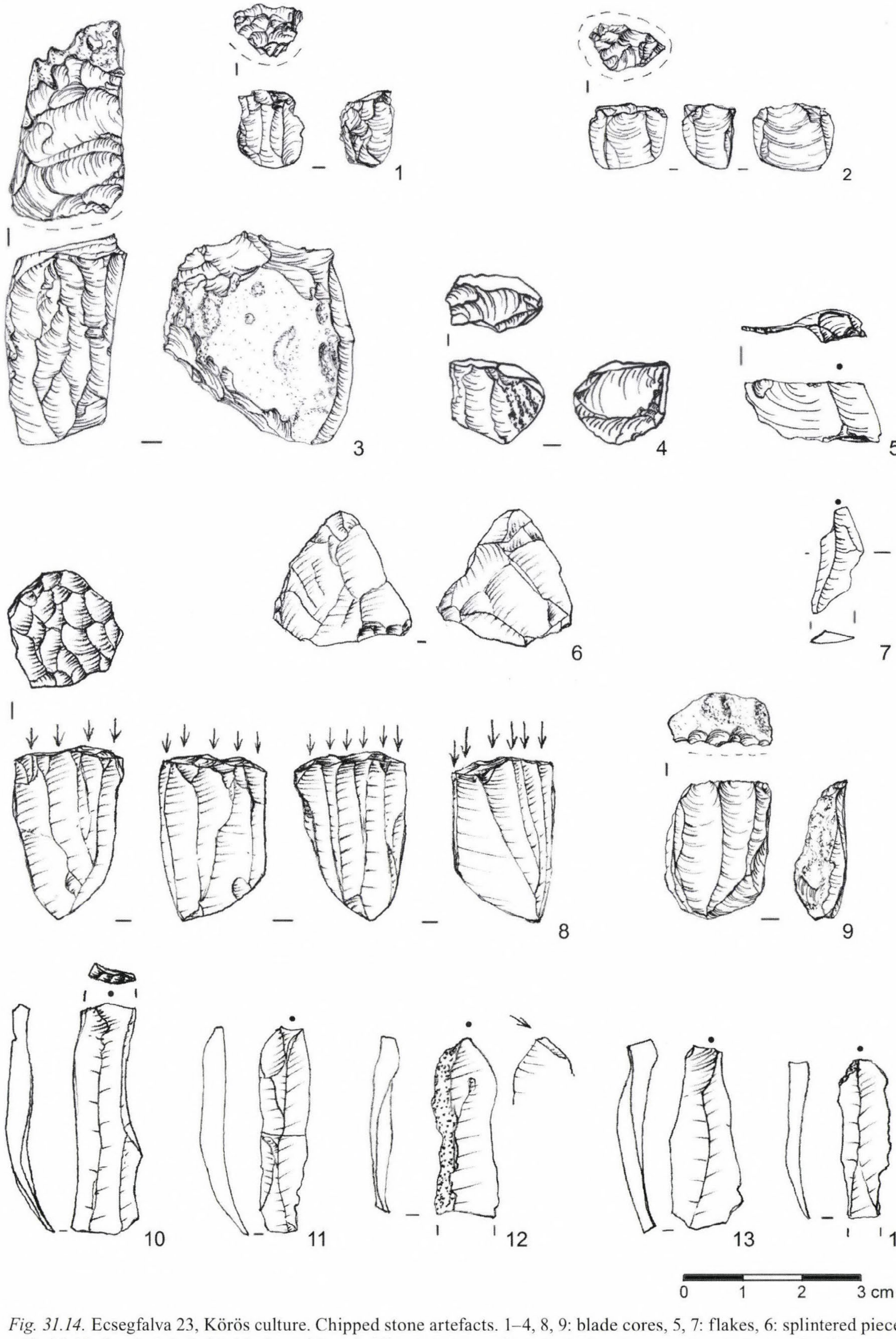


Fig. 31.14. Ecsegfalva 23, Körös culture. Chipped stone artefacts. 1–4, 8, 9: blade cores, 5, 7: flakes, 6: splintered piece, 10–14: blades. 1–4, 8, 9, 11–14: Carpathian obsidian I, 5: Banat flint, 6, 10: limnic quartzites, 7: Szentgál radiolarite. 1–5, 7–9: drawn by I. Mateiciucová, 6, 10–14: drawn by T. Marton

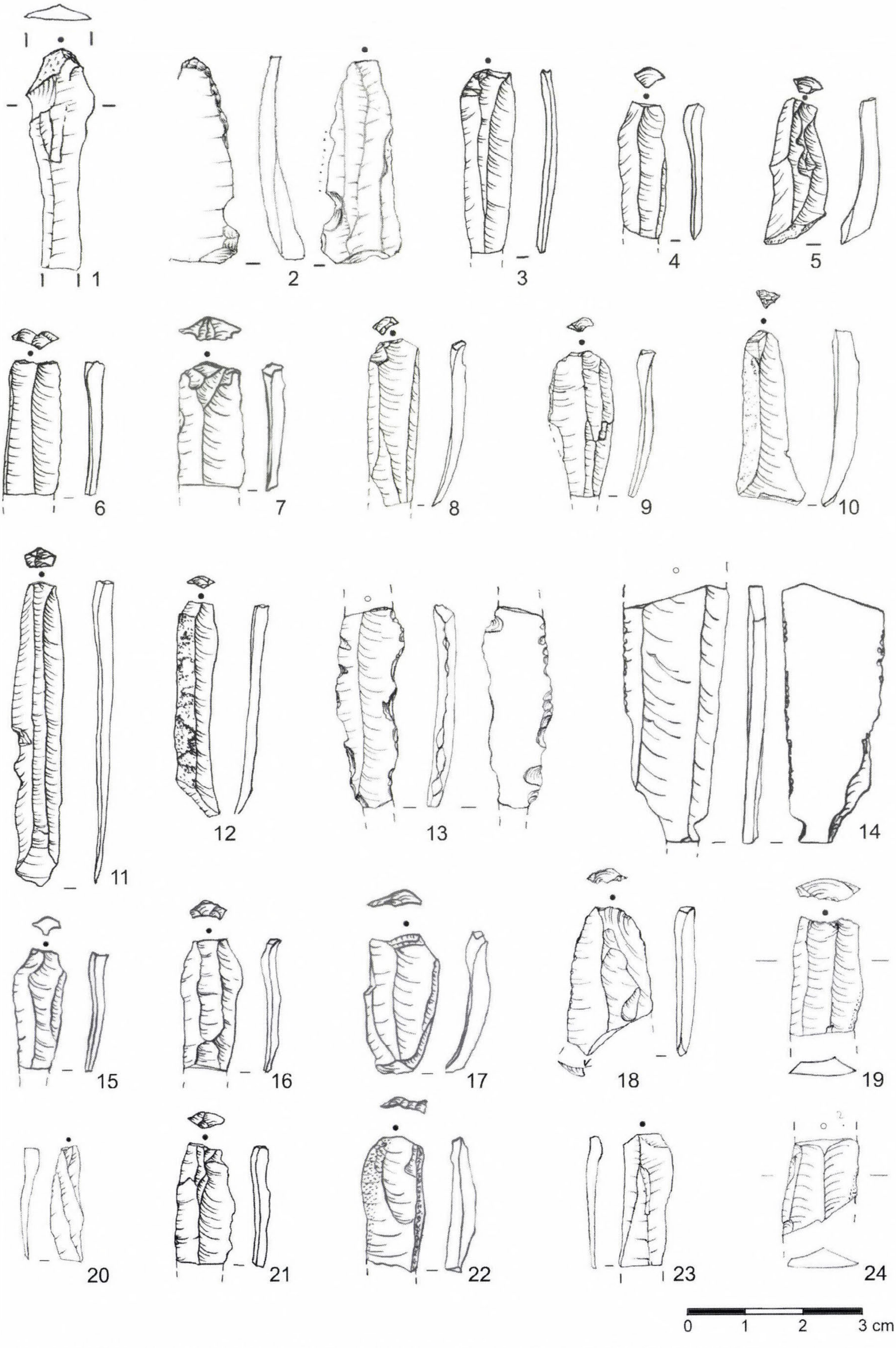


Fig. 31.15. Ecsegfalva 23, Körös culture. Chipped stone artefacts. Blades. 1, 4–7, 12, 15, 17, 21–24: limnic quartzites, 2, 8–11, 13: Mezőzombor limnic quartzites, 3: Volhynian flint, 14, 16, 18, 20: Carpathian obsidian I, 19: limnic quartzite. 1, 2, 20, 23: drawn by T. Marton, 2–19, 21, 22, 24: drawn by I. Mateiciucová

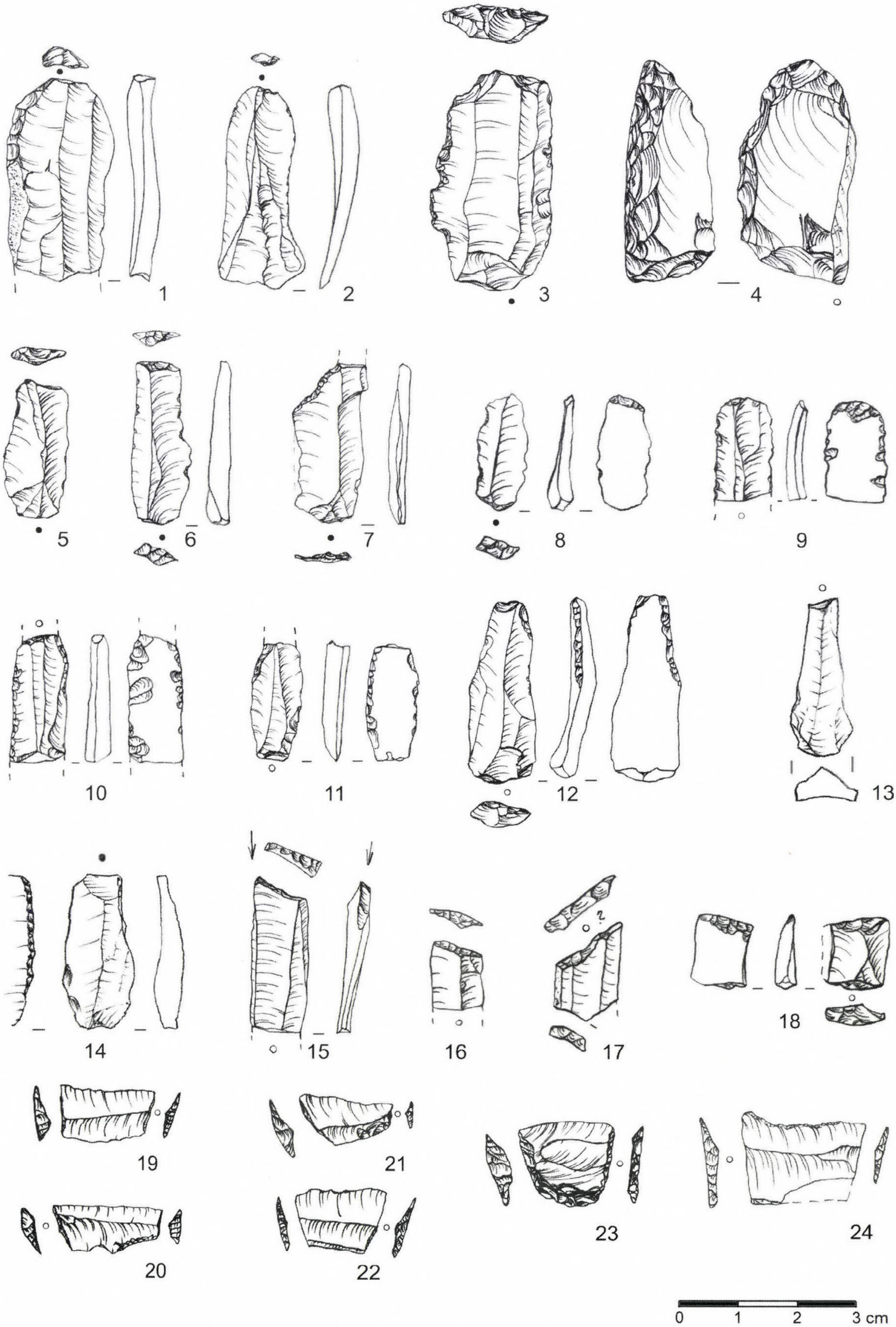


Fig. 31.16. Ecsegfalva 23, Körös culture. Chipped stone artefacts. 1, 2, 13: blades, 3: end-scraper, 4: side-scraper, 5, 6, 16, 24: truncated blades, 7: fragment of a notch, 8, 9: truncated blades-ventral, 10: fragment of a tool (borer), 11, 12: fragment of borers, 14: lateral retouched blade, 15: truncation burin, 17: trapeze point, 18–23: trapezes. 1, 2, 6–11, 13, 16, 18, 22, 23: Carpathian obsidian I, 3: porcelanite, 4, 13, 15, 17, 20: limnic quartzites, 5, 12, 14, 21, 24: Mezőzombor limnic quartzites, 19: burned limnic quartzite. 1–12, 15–24: drawn by I. Mateiciucová, 13, 14: drawn by T. Marton.

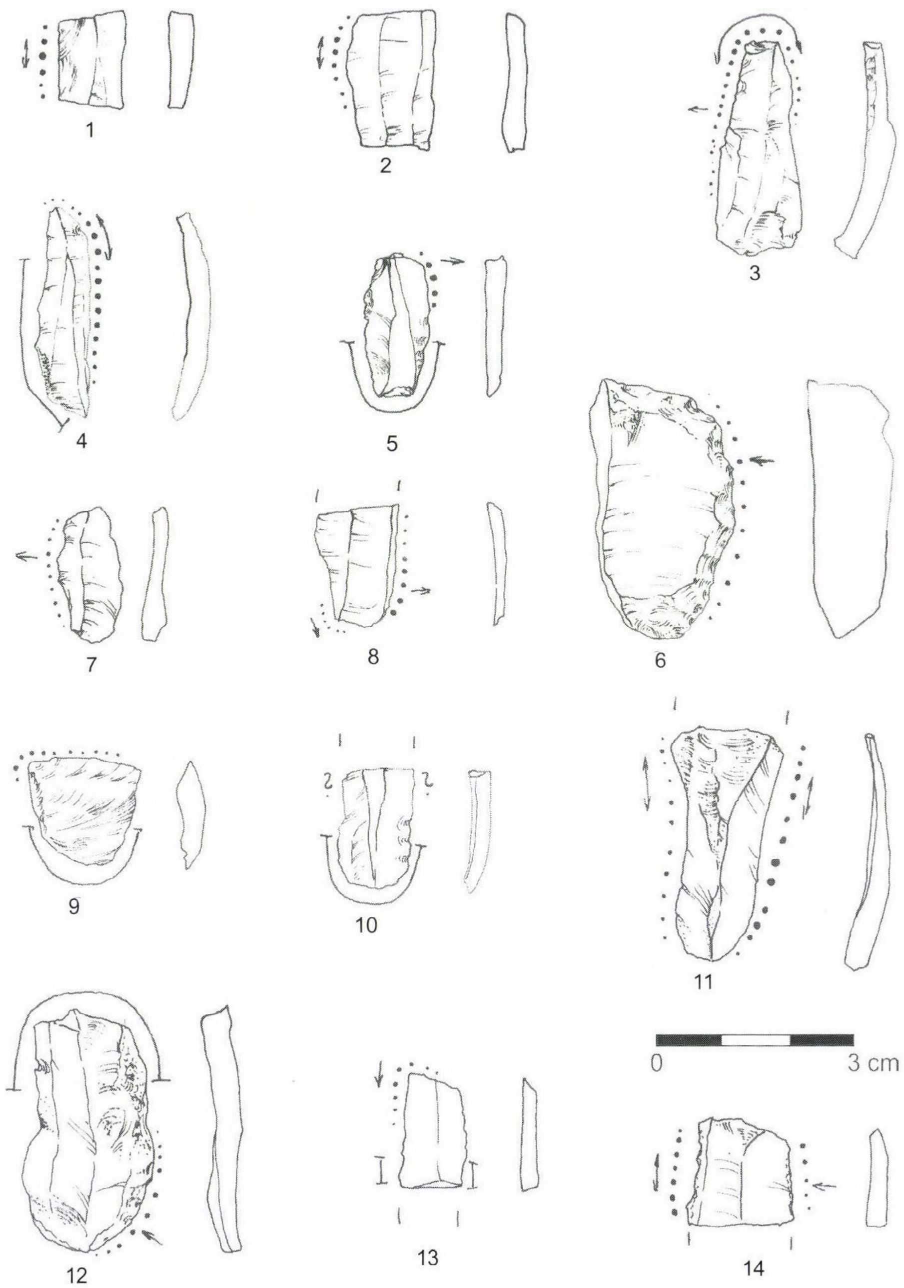


Fig. 31.17. Selected functional tools from Trench B: drawn by K. Szczesna

The characteristics of the chipped stone industry from Ecsegfalva 23: a summary

1. At Ecsegfalva 23 (Trenches A, B and C), a total of 465 flint and obsidian artefacts were found. This is the largest collection of chipped stone industry stemming from the Körös culture, with the exception of Méhtelek-Nádas (Szatmár phase). For further study 445 were selected.
2. The Ecsegfalva 23 settlement was located at some distance from raw stone material sources suitable for the production of chipped stone industry *(Fig. 31.10).* Raw materials from northern areas were preferred. At that time, these areas lay beyond the areas inhabited by Körös and other Early Neolithic populations and were probably inhabited by Mesolithic hunter-gatherers.

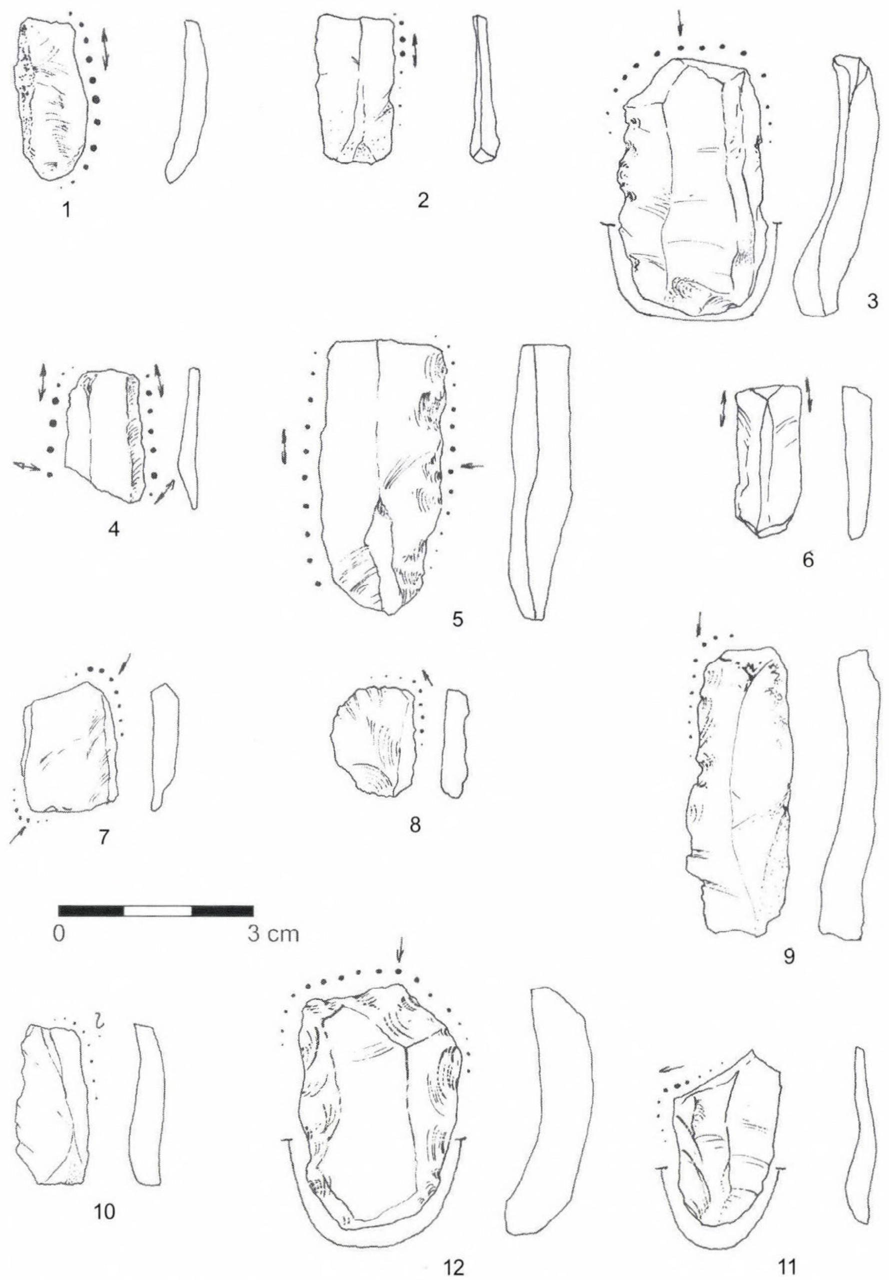


Fig. 31.18. Selected functional tools from Trench B: drawn by K. Szczesna

3. Two raw materials dominate: first limnic quartzite and second Carpathian obsidian *(Fig. 31.11).* Limnic quartzites are typical of the area of the Tokaj Mountains in north-eastern Hungary. Often a notable and aesthetic striped variety, Mezőzombor, from the South Tokaj area was used. Among the Carpathian obsidians, a dark grey to black translucent to transparent variety, so-called Carpathian Obsidian 1 from the Slovakian side of the Tokaj-Zemplén Mountains predominates.
4. Banat flint so characteristic of Körös and Starčevo settlements provides evidence of southern connections with the Balkan Neolithic. At Ecsegfalva 23, this source was identified in only two cases *(Fig. 31.11. 14, 16).*

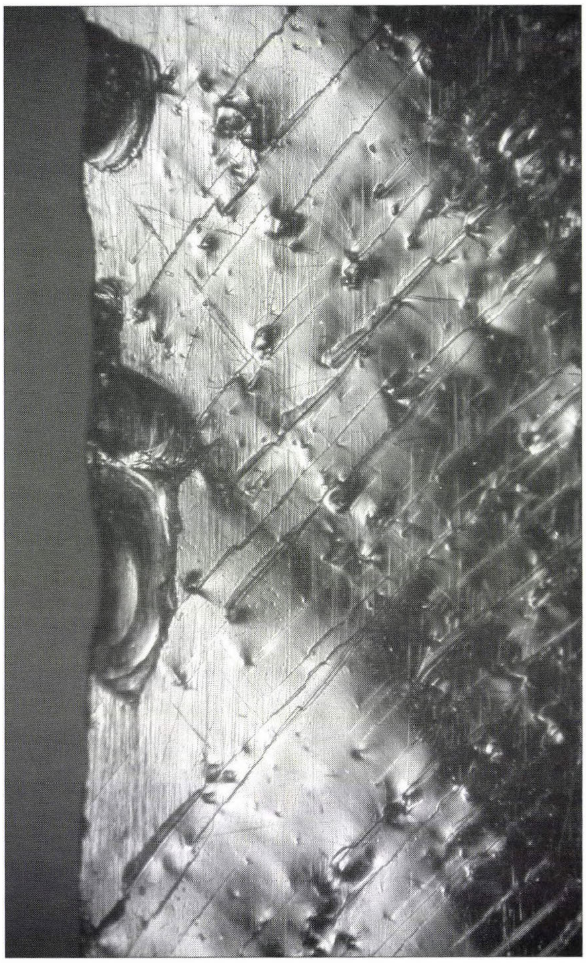


Fig. 31.19. An edge of a sickle/knife insert used in soft-plant gathering, magnification x125

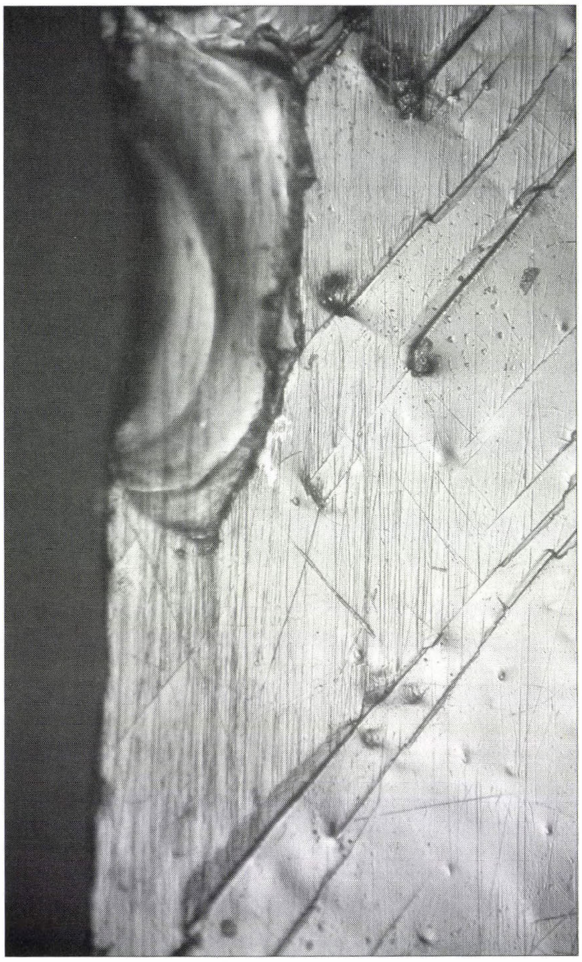


Fig. 31.20. An edge of a sickle/knife insert used in soft-plant gathering, magnification x250

5. Western contacts, probably with Starčevo communities or Late Mesolithic communities north and west of Balaton, are indicated by two flakes of Szentgál Radiolarite from the Bakony Mountains in North Transdanubia *(Fig. 31.11. 15).*
6. Two different distribution patterns were recognised:
   a. the *Danubian distribution pattern,* which dominated. After this distribution pattern raw stone material were procured in the form of prepared pre-cores, cores and occasionally in the form of blade blanks and ready tools. This model is characteristic for the LBK culture. Limnic quarzite and obsidian used at Ecsegfalva 23 was probably obtained through an exchange or by direct expeditions to the primary sources. I envisage that the Danubian distribution pattern was usual in the local Late Mesolithic in the Balkans and Central Europe.
   b. the *Balkan distribution pattern* is linked to the distribution of finished products (blades and tools) made from Balkan flint, which were manufactured in specialized centers. This distribution pattern was common for Early Neolithic Balkan cultures.
7. The overall production of chipped stone industry at Ecsegfalva 23 can be characterised as blade production.
8. The blades are small and quite narrow. The platform remnants are mostly primarily faceted, without dorsal reduction. Blades made from limnic quartzite indicate also plain platform remnants, likewise without dorsal reduction.

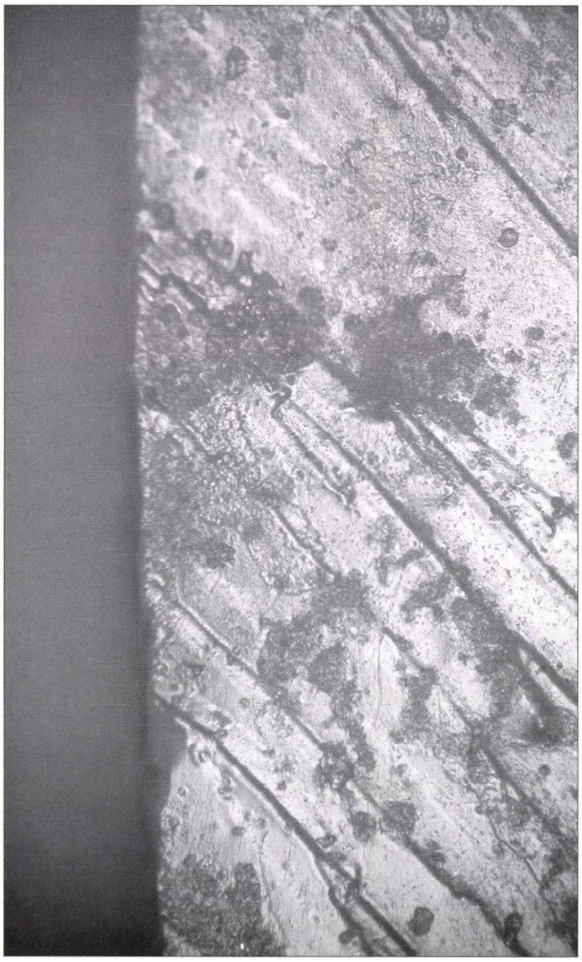


Fig. 31.21. An edge damage of wood-hafting, magnification x125

Fig. 31.22. An edge of a knife used in hide cutting/scraping, magnification x125

9. These blades were produced by the punch technique. I suggest this technique is a relic of a local Mesolithic tradition, the so-called *Danubian tradition.*
10. Apart from one exception, these for Early Neolithic Balkan cultures characteristic robust long regular blades associated with pressure technique are missing at Ecsegfalva 23.
11. Most of the blades and blade tools from obsidian carry evidence of intensive use. Although traces of use are rather rare on blades manufactured from limnic quarzite. Was the supply of obsidian and limnic quartzite to Ecsegfalva 23 separated by time intervals, with obsidian acquired earlier and limnic quartzite acquired later? Is the difference in degree of use the result of the different quality of the raw materials?
12. Almost all the tools were produced on blade blanks. The proportion of limnic quartzite and obsidian is quite equal among the tools.
13. The spectrum of tools is similar as in the earliest phase of LBK (Brunn II, Szentgyörgyvölgy-Pityerdomb). Truncated blades and trapezes are the most numerous.
14. Trapezes are long (AA) and short (AZ). The long trapezes are probably relics of an indigenous Mesolithic tradition in south-eastern Central Europe. Broad trapezes (transverse arrowheads, AC) are missing at Ecsegfalva 23, although they predominate at other Körös culture sites. The trapezes may have been used as arrowheads, or as harpoon and spear inserts and indicate hunting and fishing.

Fig. 31.23. An edge of a sickle insert used in cereal(?)-harvesting, magnification x125

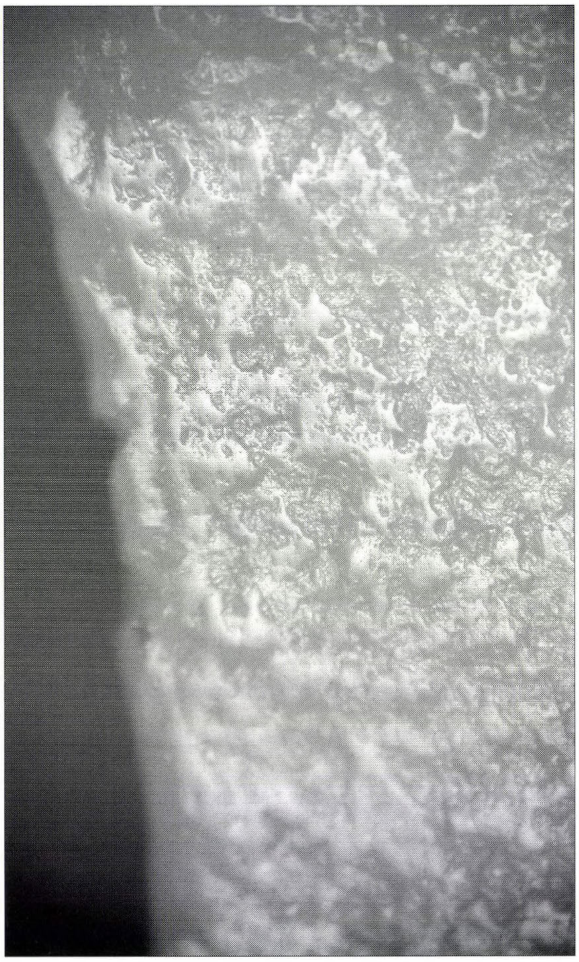


Fig. 31.24. An edge of a sickle/knife insert used in soft-plant gathering, magnification x125

15. Lateral retouched blades, which are characteristic tools of the Early Balkan Neolithic period and the Körös and Starčevo cultures, occurred only in one typical sample at Ecsegfalva 23. This kind of tool is also nearly absent in the Earliest LBK.
16. Blades with visible 'sickle' gloss are small and mostly unretouched. In addition to grain, they also may have been used to cut grass and reed. Unretouched sickle blades are typical for the Early LBK.

Conclusions

Two questions were asked at the beginning of this report:

1. Who were the inhabitants of Ecsegfalva 23? Who were the people, who are known as the Körös culture?
2. How did people at Ecsegfalva 23 live?

From the study of the chipped stone industry at Ecsegfalva 23, and from comparisons with other Körös, Starčevo, Earliest LBK and Mesolithic sites, I presume that is possible to see two different traditions in the Körös culture. These traditions are signified by:

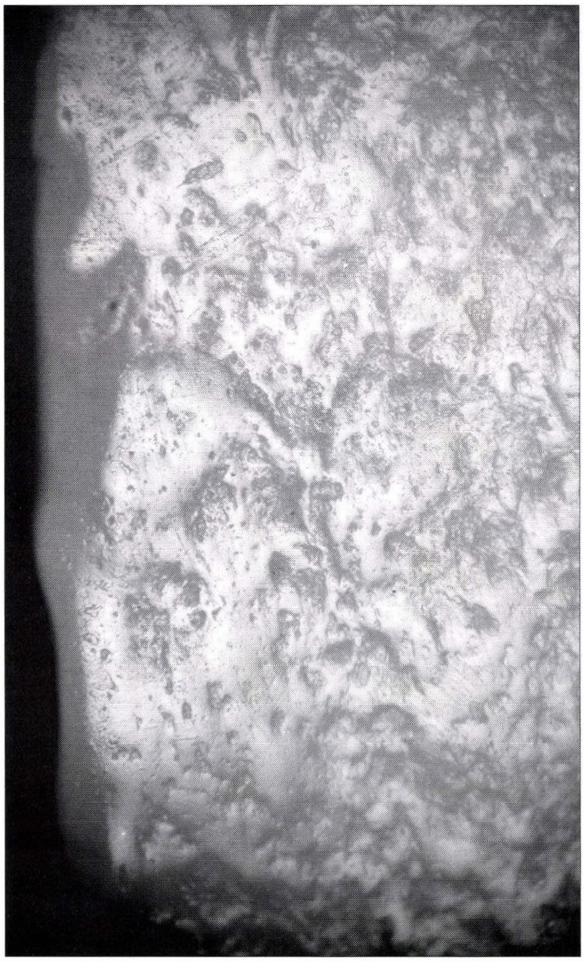


Fig. 31.25. An edge of a sickle/knife insert used in soft-plant gathering, magnification x125

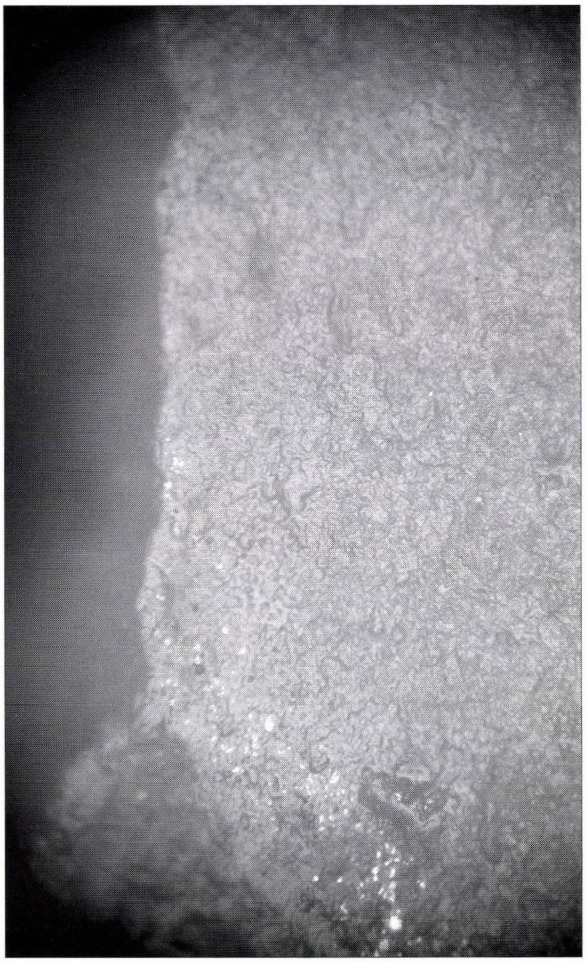


Fig. 31.26. An edge of a wood-scraper, magnification x250

a. The use of different techniques of blade blank production;
b. The use of different kinds of stone materials, the sources of which lie in culturally different areas;
c. Differently organised distribution networks; and
d. The production of different types of tools.

These differences do not have exclusive validity, of course, and several exceptions exist, although I suggest that these features appear with a certain regularity and are related to each other. I am aware of the fact that in some instances one difference is determined by another. So, for example, large blades are practically predetermined in the production of broad trapezes (transverse arrowheads) due to their width, while small and quite narrow blades were ideal blanks in the production of long trapezes.

Two different traditions were identified by the study of chipped stone artefacts of the Körös culture: *Mediterranean* and *Danubian*.

The *Mediterranean tradition* is associated with:

a. blade production by the pressure technique;

b. the use of good quality raw materials, the primary sources of which lie in areas inhabited by Early Neolithic populations (especially Banat flint);
c. the *Balkan distribution pattern*: the production of blade blanks outside the settlement (cores are missing and only a few flakes are found on the settlement), and probably in specialised workshops;
d. the production of large robust blades, used as multifunctional tools;
e. the use of laterally retouched blades; and
f. the use of broad trapezes (AC, transverse arrowheads) and short trapezes (AZ).

The Mediterranean tradition is connected with blade production by the pressure technique (Mateiciucová 2002a, 246–47; 2004). Its origin can be found in the Epipaleolithic and Proto-Neolithic cultures of Central Asia and the Near East. This new technology was spread to the Mediterranean and south-eastern Europe during the Late Mesolithic and the Early Neolithic period. Together with the production of regular blades, the first trapezes appear, and already spread throughout Central Europe during the Late Mesolithic period (S. K. Kozłowski 1987). The spread of technological innovation of blade production was related with more and more intensive communication between Europe and the Near East, sporadically beginning in the Boreal period (Melos obsidian in Franchthi) and culminating in the acceptance of the Neolithic way of life during the Early and Middle Atlantic. The Mediterranean tradition is limited to the areas of Earliest Neolithisation in Europe. In the Balkans, the Mediterranean tradition appears in the Early Neolithic Starčevo-Körös-Criş cultural complex where is it connected with the use of Banat flint. The Mediterranean tradition did not spread northward to Central Europe and evidence of it was not found in northern Transdanubia, Moravia or Lower Austria (Mateiciucová 2002a, 247; 2004, 93).

The Mediterranean tradition in the Balkans is connected with a specific distribution pattern based on the production of robust regular blades in specialised workshops and its redistribution in the settlements. Were the uniform robust blades part of a personal inventory, or were they common tools as in the case of other blades produced directly on the settlement?

At Ecsegfalva 23 evidence of the Mediterranean tradition is nearly absent. The decrease of blades from Banat flint in the later phases of the Starčevo and Körös cultures may be attributed to the location of settlements more distant from the supposed primary sources (Starnini 1994b; Starnini and Szakmány 1998; Biró 2002, 122–24). In these more distant settlements they are displaced by the blades from obsidian and limnic quartzite, which are made by the punch technique. In some cases, obsidian and limnic quartzite blades made by pressure occur (Bacskay and Siman 1987; Starnini and Szakmány 1998).

At Ecsegfalva 23, limnic quartzite and obsidian blades made by the punch technique dominate. I connect this way of blade blank production with the so-called Danubian tradition.

The *Danubian tradition* is associated with:

a. the production of regular blades by the punch technique;
b. the use of raw stone materials the primary sources of which lay outside of the distribution of Balkan Early Neolithic cultures (limnic quartzite, Carpathian obsidian, Szentgál radiolarite), in an area inhabited by hunting-gathering communities;
c. the *Danubian distribution pattern*: the production of blade blanks on the settlement (the presence of pre-cores, cores, flakes and waste on the settlements);
d. the production of small blades;
e. the absence of the lateral retouched blades; and
f. the production of long (AA) and short (AZ) trapezes.

The Danubian tradition has roots in the Late Mesolithic of south and south-eastern Central Europe[18] and developed as a local answer to innovations and new ideas coming from the Near East, and later from the Mediterranean.

Late Mesolithic communities of south-eastern Central Europe more often came into contact with Late Mesolithic and later also Early Neolithic communities of the Balkans *(Figs 31.9–10)*, and thus with the Mediterranean tradition of blade and trapezes production.[19] Through these interactions, Late Mesolithic inhabitants of south-eastern Central Europe developed their own way to produce regular blades. These regular blades were produced not by the pressure technique but by their own technique: the punch technique. I call this technological adaptation a *variation on the Mediterranean tradition* (Mateiciucová 2002a, 246–47; 2004, 93). The blades made by the punch technique were not as long and regular as those made by the pressure technique, but their dimensions also correspond with the possibilities of the raw stone material.

The tendency for regular blade production is already indicated in the Late Mesolithic sites in the western and northern Hungary at the Kaposhomok, Jásztelek I, Jászberény II, Jászberény III and in south Moravia at the site Dolní Věstonice 'Písky' (Marton 2003; Mateiciucová 2002a, 243; 2004).[20] All of these sites have also yielded trapezes.

The production of small regular blades by the punch technique was identified at Ecsegfalva 23 and other sites of the Körös and Late Starčevo culture as well as the Szatmár phase. Very similar blades to those found at Ecsegfalva 23 are characteristic for the earliest phase of LBK (Szentgyörgyvölgy-Pityerdomb, Brunn IIa, Brunn IIb) (Mateiciucová 2002a, 239–40; 2002b, 172–73). In all these sites, blade production is restricted to the settlement area. This means that the material from which the blade blanks were made arrived at the settlement in the form of prepared pre-cores and cores (the Danubian distribution pattern).

In the Late Mesolithic of south-eastern Central Europe, as well as at Ecsegfalva 23 (excluding one artefact from Banat flint) and in the Earliest LBK, regular lateral retouched blades are absent.

Limnic quarzite and Carpathian obsidian were preferred at Ecsegfalva 23. The raw material sources lay outside the distribution of the Körös culture or any other Early Neolithic culture. Late Starčevo culture settlements indicate a preference for Transdanubian (Szentgál) radiolarite, the sources of which also lie outside the area of its distribution.

What else was indicated by the study of chipped stone artefacts? How did people at Ecsegfalva live? Were they above all farmers or can additional activities also be determined (hunting, fishing and so on)?

According to the use-wear analysis (see below), a large amount of small blade tools were fixed in a handle or inserted into a shaft. It was also determined that unretouched artefacts were often used as tools. These tools were used mostly for cutting soft materials. Some served as sickle inserts and knives and were used for crop harvesting. It may also be that they were used for cutting reeds and other kinds of grass which also may have served as materials for building (see Carneiro and Mateiciucová, chapter 13), mats, or other objects of everyday use. Most of the artefacts which were examined for use-wear indicate traces of wood, skin or similar material.

Limnic quartzite was preferred for processing soft materials. On obsidian, traces of this kind of use were found in only one case (see Małecka-Kukawka, below). This may be because obsidian tools were considered unsuitable for this kind of activity, or it may due to the difficulty of recognising these kinds of traces of use on obsidian. In other cases, no specific differences were identified in the use of obsidian and limnic quartzite. The use of both materials was quite equal for different activities.

At Ecsegfalva 23 a collection of long and short trapezes was found. The trapezes probably served as inserts of single or composite arrowheads *(Figs 31.12–13)*. It is also possible that trapezes together with unretouched blade fragments served as inserts for harpoons. According to the archaeozoological analyses, the hunting of birds and fishing (including pike and carp) were significant seasonal activities of the inhabitants of Ecsegfalva 23. Erika Gál (chapter 19) identified the skeletal remains of predatory birds (buzzard, goshawk, booted eagle). Flight and tail feathers of predatory birds were very suitable for arrow shafts.

I suggest that in addition to bird hunting and fishing, game also formed an important part of the subsistence and lifestyle, even though the proportion of wild animals in the faunal remains does not indicate this. It is probable that game hunting was a seasonal activity which took place outside the settlement and only for a certain period of the year. Possibly only conserved (smoked?) meat, probably in the form of fillets and hunting trophies, was available on the settlement and would have yielded a minimal quantity of bones (Outram and Rowley-Conwy 1998, 839). For this reason, the proportion of skeletal remains of wild animals was not very significant at Ecsegfalva 23. I suggest that the occurrence of limnic quarzite and Carpathian obsidian at Ecsegfalva 23 was closely connected with seasonal hunting in the foothills. It is possible that larger groups met for the hunt. During these occasions alliances were formed and reinforced with communities from other regions. At this time, raw stone materials could be procured and exchanged with local Mesolithic communities. In seasonal camps near these sources, the raw materials were prepared into transportable forms. Tools were also needed for hunting such as arrowheads.[21]

It is possible that arrowheads were lost or damaged during the hunt. The production of transverse arrowheads takes only few minutes (Paulsen 1990, 303) and damaged arrowheads could have been easily exchanged for new ones. It is not surprising, therefore, that the trapezes at Ecsegfalva 23 carry little evidence of usage.

According to the present state of knowledge, the results of chipped stone artefacts studies from Ecsegfalva 23 and their comparison with chipped stone assemblages from other Early Neolithic and Late Mesolithic sites, I suggest that the Körös culture carries elements of the Early Balkan Neolithic as well as relics of Late Mesolithic traditions. Mesolithic traditions are also recognisable in the late phase of the Starčevo culture and they are most significant in the earliest phase of the LBK culture (Whittle 1996, 85–86, 150–52, 363–64; 2001a, 454–55; Mateiciucová 2002a, 328; 2004; Bánffy 2004, 375–76, 383).

So, who were the inhabitants of the Ecsegfalva 23 settlement? I suggest that the inhabitants of Ecsegfalva 23 were a biologically mixed population of indigenous Late Mesolithic inhabitants of the Carpathian basin and Early Neolithic communities of Balkan origin. Their subsistence was based on farming. They grew cultivated crops and bred sheep/goat and cattle. Beside these activities they also sought out water fowl, fished and in the appropriate season hunted wild animals.

The original Late Mesolithic tradition ('the Danubian tradition') occurred mainly in the northern periphery of the Körös culture. Increased interactions (the exchange of obsidian and limnic quartzite and other raw material sources and products, and hunting in the foothills) and more intense relationships (the creation of new relationships and kinship ties, marriage alliances, and making contracts) of the Starčevo and Körös cultures with Mesolithic foragers accelerated the Neolithisation of these northern and north-west regions. This Neolithisation concluded with the origin of the LBK and AVK cultures *(Figs 31.9–10).*

Acknowledgements

I would like to sincerely thank Alasdair Whittle for the invitation to work on the chipped stone artefacts and for inviting me to take part in the Ecsegfalva Workshop held at Cardiff University in May 2003. Finally, I would also like to thank Petra Málková and Alena Lukes for translating, Kerstin Pasda for critical comments and literature, and Alasdair Whittle for correcting the text, and for reading and commenting on the final draft of this paper.

Use wear analysis

Jolanta Małecka-Kukawka

Use wear analysis of selected limnic quartzite, flint and obsidian materials from the assemblage from Trench B of Ecsegfalva 23 was conducted at the Institute of Archaeology, of Nicolaus Copernicus University in Toruń (Poland). Traceological studies have been conducted in Toruń for ten years. Microwear analysis utilises two computer-microscope assemblies. The first is a stereoscopic Nikon SMZ-2T with objective zooms from 2 to 12.6 with a xenon light source. The second is a stereoscopic Zeiss-Axiotech with incident light and the following objectives: x5, x10, x20 and x50.

The implements are examined under various magnifications, so that the potentially and actually used areas can be identified. This procedure enables us to recognise the features of the working edges, localise the traces of use in relation to the edges, describe the macrowear traces, identify glosses and occasionally striations, as well as any other diagnostic features which may occur. The successive stage of examination is a detailed analysis of the gloss features and other diagnostic elements, during which the Zeiss-Axiotech set is used. Most of the micrographs, which depict the selected characteristic microwear traces, are made with the Axiotech (most of the time at objective magnifications of x10 and x20).

The production of experimental specimens has played an important role in the methodology of research into the function of the tools. The basic role of experimental archaeology in microwear analysis has two aspects. First, it has an educational character. Performing different activities using flint tools enables the researcher to observe systematically how the tools work, how the edges become worn and how long this process takes, and finally at what point the tool ceases to be functionally effective. Secondly, as a result of controlled experimental procedures we obtain specimens of certain types of tools. These can later be used for comparative purposes in the study of archaeological material.

Experiments of this type have also been performed at Toruń since 1995. We now have a collection of some 200 tools which have been used in performing various activities. Cereal harvesting has been carried out using composite sickles: the inserts being made from the various types of flint used in the Neolithic. Other activities carried out include the gathering of both grass and winter reeds, hide-working, and the working of other materials including wood, bone, antler, shell, amber, and soft stones such as sandstone *(Figs 31.27–30)*. The basic aim of these experiments was to obtain tools with well-developed wear-traces, which could then help in identifying and interpreting of the different traces of wear displayed on prehistoric tools.

For the purpose of the Ecsegfalva material analysis a series of experiments has been conducted with the use of obsidian tools.

As a result of microscopic analysis of 36 tools selected from the Ecsegfalva material, it was discovered that 26 of the artifacts have sign of use wear, and of those, ten tools served two functions. In total 36 different activities were performed with those 26 tools. Few function groups can be mentioned:

– Tools for cutting green (soft) plants: four functions;
– Tools for working wood (scraping, carving, whittling, sawing, shaving, drilling): eight functions;
– Tools for working animal hide (scraping, cutting): four functions;
– Tools for working bone/antler (scraping, sawing): five functions;
– Cutting meat: three functions;
– Tools for cutting cereals: probably one function.

Fig. 31.27. Dry reed (winter)-cutting experiment

Fig. 31.28. Hide-scraping (fresh hide) experiment

For the remaining tools it was impossible to precisely identify their function. It was only possible to distinguish whether they were used to work soft or hard material, and sometimes, it was only possible to state that they were used, without specifying character of their function

Fig. 31.29. Green-grass gathering experiment

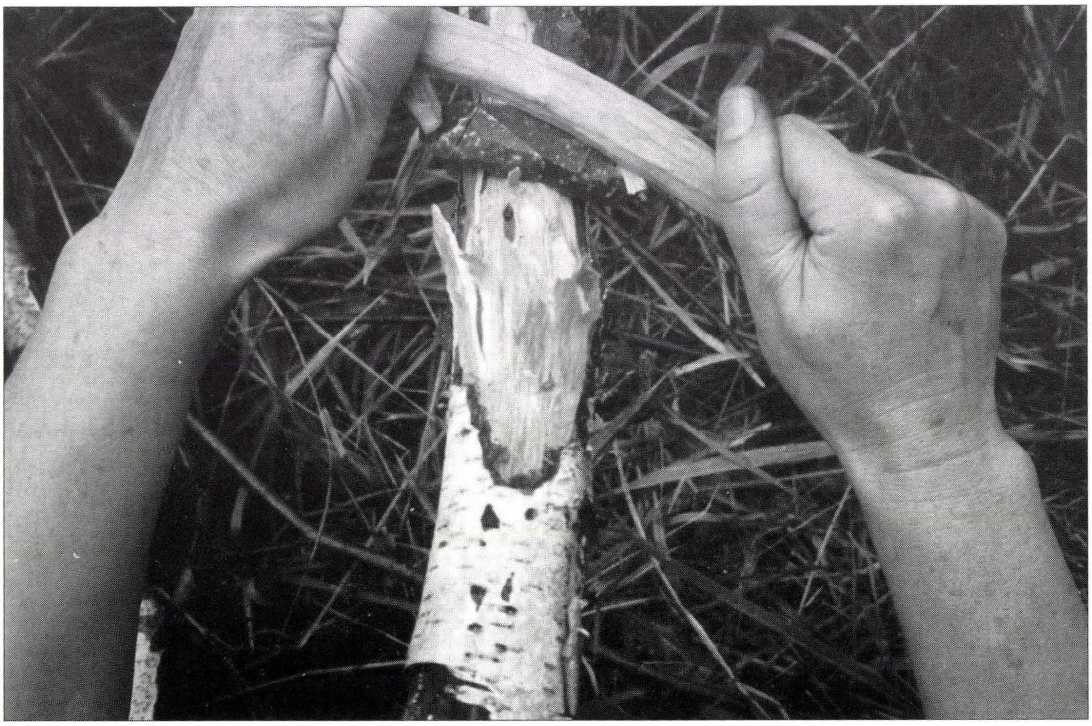


Fig. 31.30. Whittling experiment on birch

or material in which they worked. This is a result of the bad state of artifact preservation (post-depositional damage), the inadequate size of preserved artifact fragments, or the lack of a full set of diagnostic features.

Table 31.29: Results of microscope analysis of materials from Ecsegfalva 23B

Inventory number	Raw material	Motion	Working edges	Contact-material	*Figs*
12045/443	Limnic quartzite	cutting	left	soft plants	*31.17. 1*
7403/352	Limnic quartzite	cutting	left	dry hide	*31.17. 2*
9357/515	Limnic quartzite	1. scraping 2. boring	1. left (scraping) 2.top of the tool (boring)	1. wood 2. wood	*31.17. 3; 31.26* (magnification x250)
9332/354	Limnic quartzite	cutting + hafting	right	soft plants	*31.17. 4; 31.24–25* (magnification x125)
12414/442	Obsidian	whittling + hafting	right	wood	*31.17. 5*
12396/457	Limnic quartzite	scraping + hafting	right	bone/antler	*31.17. 6*
3068/301	Obsidian	whittling	left	hard material (wood?)	*31.17. 7*
3224/301	Obsidian	1. whittling 2. carving	1. right 2. left angle	1. wood 2. wood	*31.17. 8*
13722/445	Obsidian	cutting + hafting	longer edge of trapeze	meat	*31.17. 9*
4519/314	Obsidian	probably used hafting	left right	?	*31.17. 10*
7787/356	Obsidian	cutting	right left	soft material (soft plants?)	*31.17. 11; 31.19* (magnification x125); *31.20* (magnification x250)
11878/443	Obsidian	scraping/cutting + hafting	right	hide	*31.17. 12; 31.21* (magnification x125); *31.22* (magnification x250)
14675/427	Limnic quartzite	cutting + hafting	left	hide	*31.17. 13*
8756/371	Obsidian	1. sawing 2. scraping	1. left (sawing) 2. right (scraping	wood/bone/antler	*31.17. 14*
3553/301 (a)	Limnic quartzite	cutting	right	cereals(?)	*31.18. 1; 31.23* (magnification x125)
3553/301 (b)	Limnic quartzite	cutting	right	soft material	*31.18. 2*
14853/458	Limnic quartzite	scraping + hafting	end-scraper front	wood	*31.18. 3*
3078/301	Obsidian	1. cutting, whittling 2. cutting, whittling	1. left 2. right	wood	*31.18. 4*
12385/457	Banat flint	1. scraping 2. sawing	1. right (scraping) 2. left (sawing)	bone/antler	*31.18. 5*
6213/340	Obsidian	sawing	right left	hard material	*31.18. 6*
12568/457	Limnic quartzite	carving	left angle right angle	wood	*31.18. 7*
12358/445	Obsidian	carving	right angle	hard material	*31.18. 8*
13462/416	Limnic quartzite	scraping/carving	left edge, left angle	wood	*3.18. 9*
12892/461	Limnic quartzite	not interpretable	right	?	*31.18. 10*
7386/352	Obsidian	carving + hafting	left angle	wood	*31.18. 11*
11230/430	Limnic quartzite	scraping + hafting	side-scraper front	bone/antler	*31.18. 12*
12602/445	Obsidian	no traces			
9245/511	Obsidian	probably used	?	?	
3378/301	Obsidian	no traces			

Table 31.29. Continued

Inventory number	Raw material	Motion	Working edges	Contact-material	*Figs*
3135/301	Obsidian	probably used	?	?	
12536/445	Obsidian	no traces			
11261/431	Limnic quartzite	no traces			
5830/340	Limnic quartzite	no traces			
4186/313	Limnic quartzite	no traces			
5801/343	Limnic quartzite	no traces			

Notes

1 Two similar stone artefacts, described as modern flint stones, were excluded from analysis. Both artefacts were manufactured from the same raw material untypical for Körös culture: like Jurassic-Krakow flint?

2 I would like to thank Elisabeth Starnini for allowing me access to the chipped stone artefacts from Endrőd 39.

3 I am indebted to Katalin T. Biró (Hungarian National Museum, Budapest) for confirming the presence of Mezőzombor limnic quarzites at Ecsegfalva 23.

4 Two blades from this raw material fit together (both from context 358, Find Nos 7985/1, 7985/2).

5 C14 dates of layer C are Deb-1966: (δ13C PDB-7.61) 8030±250 BP and Deb-2466: (δ13C PDB-10.09) 7350±80 BP (Kertész *et al.* 1994, 28).

6 On the Gellénháza-Városrét settlement westward of Balaton, occupation dating to the late phase of the Starčevo culture and the Sopot-Bicske culture was identified. I am indebted to K. T. Biró (National Museum in Budapest) for allowing me access to the material.

7 An exception and also a strange case is the cache of flakes from Banat flint at Endrőd 39 (Kaczanowska *et al.* 1981).

8 I am indebted to Eszter Bánffy (Archaeological Institute of the Hungarian Academy of Sciences, Budapest) for allowing me to study the chipped stone artefacts from the settlement of the earliest phase of LBK at Szentgyörgyvölgy-Pityerdomb.

9 The occurrence of truncated blades overlaps to a certain degree with the occurrence and spread of trapezes. Can some truncated blades be considered as 'blanks' or more likely 'intermediates' in the production of trapezes? In the LBK, trapezes occur mainly in the earlier phase and are concentrated in the SE distribution of this culture.

10 I would like to thank Róbert Kertész for allowing me to study materials from Mesolithic localities in the Jászság (Damjanich Museum, Szolnok) area.

11 Most of the artefacts that Gronenborn considered as trapeze points are unfortunately only truncated blades (Mintraching, Schwanfeld) (Gronenborn 1997, 100, Taf. 3.2. 1–3, Taf. 5.3. 25, 31).

12 Thin perforators of the 'mèche de forêt' type (with a weakly distinguished point) appear in the early phase of the LBK more often than borers of this type (Małecka-Kukawka 1992, 65, Tab. 3: 6, 7; Gronenborn 1997, Taf. 1. 2–13, 14, Taf. 5.4. 1–5, Taf. 6.2. 9, 11, 14; Mateiciucová 2002a, 255–56; 2004; 98–99).

13 One fragment of a large, thin blade of Carpathian obsidian was also found at Ecsegfalva 23 on the surface, unfortunately without context *(Fig 31.15. 14).*

14 I presume that some of the large regular blades of the Körös culture were also produced by the punch technique. Unfortunately, I have not yet had the opportunity to conduct a closer study of chipped stone artefacts from other Körös culture sites.

15 All experimentally made blades match this scheme, except experiment no. 4 which involved blades made by pressure. These resulted in ridged blades directly from the beginning of core reduction.

16 Jásztelek I, Jászberény I-layer B2, Jászberény II, Tarpa-Márki tanya in southern Hungary (Kertész 1993, 89–90; 1994, 26; Kertész *et al.* 1994, 19), Kaposhomok in Transdanubia (Kertész 1993, 89–90; Marton 2003, 46), Sered', Dolná Streda and Hurbanovo in western Slovakia (Bárta 1957; 1959; Kozłowski 1981) and Dolní Věstonice, Šakvice and Mikulčice in southern Moravia (Klíma 1953; 1970; Škrdla *et al.* 1997) are considered to be Late Mesolithic sites. The sites of Sered', Jásztelek I and Jászberény I have been confirmed stratigraphically. Other sites are known only from surface finds and were attributed to the Mesolithic period due to the appearance of trapezes.

17 Unfortunately several fragments of LBK pottery at Jászberény II and two fragments of the Stroke-Ornamented Ware at Dolní Věstonice were recovered and it is thus impossible to rule out later Neolithic intrusions.

18 It cannot be excluded that in some Balkan regions blade production by the punch technique occurred in connection with the Danubian tradition.

19 It is also possible that the search for new raw material sources suitable for the production of regular blades led to communication with, and therefore the faster spread of ideas from, the Mediterranean.

20 In south-eastern Central Europe, the so-called Terminal-Mesolithic has yet to be identified which has been documented at several sites in southern Central Europe (e.g. in south Germany) (Kind 1992; 1997, Gehlen 1999). The Terminal-Mesolithic is considered be the end of the Mesolithic period. Its characteristic feature is the production of regular blades. More information on the technology of production of these blades is still not available. Some researchers suggest the predominance of the pressure technique (Jägerhaushöhle 7) (Bauche 1987, 57).

21 As mentioned above, long and short trapezes also appear in the local Mesolithic of the Carpathian basin and in the earliest phase of LBK (Brunn IIa, Brunn IIb). It is noteworthy that in the Körös culture trapezes were made almost exclusively from obsidian and limnic quartzite. These are raw materials the sources of which lie in the area inhabited by Mesolithic foragers.

Chapter 32

ON THE WATERFRONT

Alasdair Whittle
with a contribution by *László Bartosiewicz*

In the Ecsegfalva project we set out principally to investigate environment, settlement and subsistence in the Early Neolithic Körös culture on the Great Hungarian Plain. In this final chapter, I will first review the many achievements of the project, with the help of László Bartosiewicz on the faunal remains, with some comparison as appropriate with the pre-existing state of knowledge. Then I will attempt to characterise the way of life represented by the site of Ecsegfalva 23 and its context, drawing above all on ideas of choreography, performance, conviviality and connectedness, before assessing the contribution of the project to our understanding of what came before and what came after, in the early and middle parts of the sixth millennium cal BC respectively, in terms of histories of identity. Finally, I will briefly offer some other ways of telling.

On the waterfront: technicalities

For the reasons set out in chapter 1, the project was focused on one particular part of a small micro-region at the known northern limits of the Körös culture (Ecsedy *et al.* 1982). Since the fieldwork for the project was completed, new discoveries have been made of Körös culture sites further up the Tisza than was previously known (László Domboróczki and Pál Raczky, *pers. comm.*). With that awareness, and conscious too of the position of Méhtelek in the north-east of the Plain, we cannot now be sure that the Ecsegfalva situation is genuinely on the limits of the Körös culture. The concept of boundary or frontier is probably unhelpful here (*pace* Kertész and Sümegi 2001), as I will explore further below. But the Ecsegfalva situation itself may remain much as we thought of it before: a scatter of small sites constituting the normal limits of the Körös culture, concentrated locally around the Kiri-tó meander or the channels of the Hortobágy-Berettyó, contrasting on the one hand with extensive areas of backswamp to the north, including the Nagy Sárrét, and on the other with larger and more extensive Körös culture sites locally a few kilometres to the south, on the terrace edges of the Pleistocene alluvial delta around Dévaványa (Sherratt 1982a; 1983a; 1983b), and then further beyond, to the south, west and east.

By the early sixth millennium cal BC, deciduous woodland had long been established in the area, dominated by oak and hazel but including elm, lime and other species. Percentages of grasses and sedges up to 40 per cent, however, suggest that this may have been an open-canopy, park-like woodland rather than dense forest (Willis, chapter 6). That is consistent with some of the wild animal bone and bird bone evidence (Bartosiewicz, chapter 14; Gál, chapter 19). The setting has been modelled as a mosaic of wooded and open patches (Gillings, chapter 3), and some at least of the woodland may have been concentrated in galleries along the levees of the local watercourses (Sümegi and Molnár, chapter 5). Direct evidence of this quality has not been obtained from this part of the Great Hungarian Plain until now (see Whittle, chapters 1 and 2).

It has often been assumed, from the strong correlation between Körös culture settlements and watercourses, that occupation took place in a wet and periodically flooded environment (e.g. Banner 1937; Kosse 1979; Sherratt 1980; 1982a), a setting akin, *mutatis mutandis*, to that known from more recent historical times before eighteenth- and nineteenth-century improvements (Molnár and Sümegi, chapter 4). Direct evidence of flooding in general, and of its intensity and periodicity in particular, has been much harder to obtain, and some evidence from the Upper Tisza Project for occupations in the floodplain may suggest that the situation was much more variable than we have often supposed (John Chapman, *pers. comm.*). The Ecsegfalva project does offer some evidence, however, in support of the standard view. Some aquatic plant species including *Polygonum, Potamogeton* and *Sparganium* were persistently present from before 8000 cal BC, suggesting periodic flooding, and ash from about 6000 cal BC is another possible indicator of flooding (or a wetter environment) (Willis, chapter 6); the evidence of plant phytoliths from the Kiri-tó cores is compatible with this view (Windland, chapter 7). The evidence of fish bone, shellfish, bird bone and some plant macro-remains is also compatible with this picture of a wet environment (Bartosiewicz, chapter 20; Sümegi, chapter 8; Gulyás *et al.*, chapter 21; Gál, chapter 19; Bogaard *et al.*, chapter 23). The presence of many small fish is compatible with opportunistic catches after early summer green floods (Bartosiewicz, chapter 20).

There was no visible evidence from the occupation remains of Ecsegfalva 23 itself for flood deposits, and little sign either in the extensive micromorphological samples for such, and clay coatings seen in some samples could as well come from post-occupation processes as from floodings contemporary with the occupation itself (Macphail, chapter 11). Study of the sediments of the Kiri-tó and of Mollusca from the Kiri-tó and the Ecsegfalva 23 site certainly shows an occupation placed directly by permanent, warm, shallow water in an oxbow meander established since the late Pleistocene (Sümegi and Molnár, chapter 5; Sümegi, chapter 8; Gulyás *et al.*, chapter 21; Willis, chapter 6; Windland, chapter 7). Although it was a deliberately speculative exercise, GIS modelling shows that Ecsegfalva 23 itself, on its slight rise, would remain dry longer than most other locations in the immediate vicinity, and would still be a very small island in floodwaters a metre above present average water level (Gillings, chapter 3). This aspect of Körös culture settlement should therefore remain a major goal for refinement in the future, and its resolution may require ambitious and large-scale investigation of extinct watercourses as well as of continued detailed examination of occupation deposits (Mark Macklin and Clive Bonsall, *pers. comm.*).

In this setting, occupation was begun at Ecsegfalva 23 after 5800 cal BC. Dates from the early 5700s cal BC come from both Trenches 23A and 23C, though it should be remembered that the number of determinations was small (Bronk Ramsey *et al.*, chapter 10). The date of the investigated part of the major occupation concentration, that is Trench 23B, was much better established, running from the mid-5700s cal BC to the mid-5600s cal BC. The duration of this occupation is likely to be shorter than 150 years, and most probably was in the order of 70–80 years or some three generations (taking a generation to be 25 years: Helgason *et al.* 2003; Slatkin 2004). These results make Ecsegfalva 23 one of the best dated sites not only in south-east but also central Europe (Whittle 1996; Whittle *et al.* 2002). It is clear that without a comparable number of dates and attention to sample composition and context, similar radiometric precision will not be achieved. It is worth noting, however, that the suggestion has been made of a shorter rather than longer span of occupation at Endrőd 119, related to the histories of two houses (Makkay 1992; 1996). The Ecsegfalva 23 dates have both local and wider implications. They imply that the beginnings of the occupation may have been quite modest in scale, since the earliest dates come from Trenches A and C which were seemingly not areas of extensive settlement. They may also imply that the numbers of people in the locality then increased relatively rapidly or that this place was quite quickly chosen as a favourite for continued settlement. They also indicate that the history of the place was finite. I will consider possible reasons for abandonment below but here

I stress the obvious further implication that it is likely that many if not most other Körös culture occupations had shorter rather than longer histories, and so the apparently populous landscapes mapped by the Topográfia Project for this part of the Plain (Ecsedy *et al.* 1982; Jankovich *et al.* 1989) may at any one time have been less densely settled. It is dangerous to generalise too much at this stage of research, but it is possible that in the area around Ecsegfalva sites were fewer and farther between than around Dévaványa a little to the south. Whether there were corresponding differences in site durations should be another question for future research, a significant challenge complicated by the fact that on the terrace edges around Dévaványa finite 'sites' may not easily be defined.

The early date OxA-12857 can be noted again. I will return to it later, in discussing beginnings. It may be an outlier, and it could not definitively be established whether the *Bos* in question was wild or domesticated. But like the disarticulated human skull from Maroslele-Pana burial 7 and the articulated inhumation from Topole-Bač (Whittle *et al.* 2002; Borić 2005), it might just reveal that otherwise elusive earlier human presence within the Carpathian Basin. Earlier traces of charcoal in the sediments of the Kiri-tó cannot certainly be associated with human activity (Willis, chapter 6). In either case, the scale of human activity is likely therefore to have been very limited.

From this perspective, what followed at Ecsegfalva 23 and other locations like it was at the least a strong consolidation of existing practices of short-stay, transient visits, and very possibly a more dramatic and radical transformation of the use of the area. I will discuss the question of the identity of the inhabitants below.

As detailed in chapter 9, none of the Körös culture sites around the Kiri-tó seem particularly big. Quite what that means in terms of numbers of inhabitants is another question. The extensive terrace-edge sites for example around Dévaványa, and those elsewhere which stretch to hundreds of metres in length, might have consisted at any one time of smaller units. The core of the Ecsegfalva 23 site is the ridge within which Trench 23B was located: an area some 50 by 50 m. We know from the excavation of the North and West Extensions in 2001 that this area included a part devoid of occupation, and the geophysical survey suggests others like it (Hamilton, chapter 9). If we were to think in terms of units consisting of houses or structures, accompanying large pits and middens, then there might be space for only two or three, or three or four, such units on the ridge. Precise numbers are not reconstructable without total excavation (another goal for future research) and do not in one sense matter. What does matter is the perception that it is unlikely that this was a large occupation. Both within Ecsegfalva 23 and in the immediate environs, people probably lived their lives in small-scale, face-to-face situations.

A lot of activities were maintained in this place: a concentrated form of living. Food was prepared and consumed from animals, fish, shellfish and plants, and probably birds (Bartosiewicz, chapters 14 and 20; Gulyás *et al.*, chapter 21; Bogaard *et al.*, chapter 23; Gál, chapter 19). Possibly all these were prepared or butchered on occasions close to or in the occupation, as witnessed by sheep and goat jaws on the one hand and barley rachis internodes on the other. Micromorphology has shown the presence of animal coprolites within the occupation deposits and at least on occasions if not regularly animals were therefore folded within the occupation. There is evidence from the wear on the sample of sheep and goat teeth that these animals did not necessarily roam freely (Mainland, chapter 17). There is evidence from the phytoliths that plant material was brought into the occupation (Madella, chapter 24) but whether as bedding or fodder is not clear. Much of this material littered the surfaces of the upper occupation deposit and was still abundant in the main occupation deposit. Could this have been a deliberate kind of texturing of the lived-in space, a very visual cue to the importance of the life carried on in this place (Evans 2003, chapter 3)?

An impressively large quantity of sherds were recovered (Oross, chapter 27). This abundance is rarely commented on. Should we just take it for granted, as the natural outcome of a combination of settled existence, necessary skills and readily available clay? Or could we see more in this profligacy: another form of texturing of the lived-in spaces of social existence, a demonstration of subsistence prowess and the ability to provide food and drink? Was such abundant pottery a regular part of daily life, as the range of quality of finer and heavier wares could suggest (Oross, chapter 27), or did people manufacture quantities for special occasions, perhaps associated with periodic or seasonal aggregations? One clue might lie in the relatively low incidence of lipid residues (Craig *et al.*, chapter 18), which could be explicable in terms of short use-lives for many vessels. But there are of course many unknown factors here, apart from the small size of sample analysed, and this is yet another question for future research. Other important materialities were the large and small clay weights, the former possibly connected with indirect moist heating for cooking and the latter with weaving (Oross and Whittle, chapter 28). Bone tools evoke another range of crafts and procurement and processing activities (Choyke, chapter 29), while obsidian, limnoquartzite and flint (whose procurement is discussed below) show both further on-site processing and a likely range of cutting and scraping tasks (Mateiciucová and Kukawka, chapter 31). Perhaps a variety of cutting tasks, lighter and heavier, were carried out with the small stone axes evident on the site (Starnini *et al.*, chapter 30). Small stone querns and rubbers were presumably associated with food preparation, but of what kind is not clear (Starnini *et al.*, chapter 30). None of these things makes Ecsegfalva 23 in any way special or distinctive within the spectrum of known Körös culture settlements. Indeed, compared say to Endrőd 119 to the south-east (Makkay 1992) or the various sites around Szolnok to the west (Raczky 1982; 1983a; 1988), the material repertoire here may appear a little limited.

Fire was a part of these people's lives. Although charcoal did not survive the probable shrink-and-swell of the deposits over long periods of time very well, enough was preserved to suggest that a range of woods was being used (Bogaard *et al.*, chapter 23), and there was certainly no shortage of timber round about (Willis, chapter 6). No formal hearths as such were found, though the fine-surfaced plaster found in the North Extension is compatible with some kind of oven or hearth setting (Macphail, chapter 11; Crowther, chapter 12; Carneiro and Mateiciucová, chapter 13). Cereal remains came into contact with fire, more perhaps accidentally and irregularly than in any planned or consistent manner (Bogaard *et al.*, chapter 23), but sufficiently often to suggest that fires were a regular part of the scene within the occupation; ash and charcoal fragments were constituents of the deposits examined by micromorphology (Macphail, chapter 11). Fires were presumably lit for both cooking and warmth. Fire also consumed the structures on the site (whether deliberately or accidentally I return to below), producing another rich kind of texture.

Burnt daub is a striking feature of the Ecsegfalva 23 archaeological site (chapter 9; Carneiro and Mateiciucová, chapter 13). Micromorphology and soil chemistry also suggested substantial quantities of deposit which could have been derived from partially burnt daub-covered structures (Macphail, chapter 11; Crowther, chapter 12). Many of the burnt daub fragments show the impressions of reeds and occasionally probably small pieces of wood. One striking such deposit, 458 in the North Extension, was underlain by a posthole, 602. The excavations were incomplete in this area, and not on a sufficiently large scale for this sort of question to be answered definitively. But it seems clear that all the activities discussed above were associated with the existence of built structures. These are known elsewhere in the Körös culture (Selmeczi 1969; Raczky 1983a; Makkay 1992; Lenneis 1997; Bánffy 2004, 59–61). Among others, the two at Endrőd 119 are not well defined, the surviving remains, principally of daub, coming from the top of two very large pits; the often-cited example from Tiszajenő was post-framed, and some 9 by 4 m. One of those at Szolnok-Szajol, defined mainly by burnt daub, was also rectangular, and again some 7.5 by 4.5 m (Raczky 1983a; Bánffy 2004, 60). The three-dimensional house model from Röszke-Lúdvár (Trogmayer 1966) vindicates the reality of walled and roofed structures.

As discussed in chapters 9 and 13 in this volume, it is not clear what form structures took at Ecsegfalva 23. It is possible that the excavation of Trench 23B incorporates the location of just one structure, accompanied by at least one large pit (390/395/394). Nothing larger than the examples of Tiszajenő or Szolnok-Szajol need be indicated, and post-framing could have been very light, with walls principally constituted by bundles of reeds (Carneiro and Mateiciucová, chapter 13). Such a building, a few metres long, could well have been roofed, and it is easy to assume that this was so, on the basis of all the other evidence from south-east Europe for structures, backed up by three-dimensional, roofed house models. The excavations at Ecsegfalva 23 thus far were not sufficiently complete or extensive to see whether the residues from all the activities discussed above were concentrated inside or outside the structure (or structures) in question, but the evidence from the North and West Extensions in particular is suggestive of structure and residues coinciding. Taking all these possibilities together, it is possible that we are dealing with a roofed structure, not heavily built but durable enough, which was one at least of the loci for living, work and shelter within the Ecsegfalva 23 occupation.

The situation is clearest (or least unclear) in the upper occupation deposit, reflecting that moment (around the mid-5600s cal BC as suggested by the radiocarbon dating programme) when the site was abandoned. That moment was associated with burning, which produced the quantities of burnt daub recorded. Whether this was deliberate or accidental cannot yet be established in this case. That would require a detailed forensic examination of all the remains, and over a wider area than was available from the excavations of 1999–2001, to see whether fire had broken out in one spot, suggesting accidental burning, or had been started and maintained in several, suggesting deliberate burning (Tringham 2005 and references). As experiments and observations have shown, it is hard work to achieve a thorough burning of a wattle-and-daub house (Shaffer 1993; 1999; Stevanović 2002). This could suggest that accidental burnings were likely to be quick, the roof especially going up spectacularly in flame, scorching and burning daub from the upper walls. Whether that would produce the quantities of burnt daub recorded must be an open question, but it is by no means excluded that abandonment was accompanied by deliberate domicide, or domithanasia as Ruth Tringham (2005) has termed the voluntary ending of a building through fire by its residents and associates.

Given the thickness of the deposit as a whole in Ecsegfalva 23B, the duration of the occupation as suggested by the radiocarbon dating programme, and the existence of dumped material in the upper fill of pit 390 (chapter 9; Macphail, chapter 11), a feature which belongs to the early part of the site sequence (chapter 9), it can hardly be the case that the putative structure seen at the top of the occupation deposit was the only one in use through the duration of the occupation. The material dumped in pit 390 includes both burnt daub and probably unburnt or half-burnt daub, suggesting that there may have been at least two episodes of house construction, use, and abandonment/burning. We could surmise some kind of recurrent unit, consisting of a large pit, a structure or house, and related middens. But such a unit would also be a process. Pits would have been dug not only to provide material for house construction but also to claim and tame the place in question; living in that place then took place, and when the time of the place came to at least a temporary end, material from the house or structure was returned to the earth. We can suppose that the occupation was renewed in the same way that it had all begun, with a further pit being dug and another house or structure being constructed. Obviously the excavations at Ecsegfalva were not extensive enough to uncover such other pits, though the geophysical survey may strongly suggest them (Hamilton, chapter 9). So I am envisaging a cycle of occupation, probably more or less continuous given the shorter rather than longer timescale discussed above, but with at least the possibility of short, partial or even complete abandonment within it. This simple model would also fit other more extensive terrace-edge occupations of the Körös culture, and within a repeating system there was therefore inbuilt flux and dynamism.

What other fixities and fluidities were there in this way of life? It may be preferable to avoid altogether the clumsy term of sedentism (Milner 2005). We can think of this as a permanent system. The place of Ecsegfalva 23 endured for perhaps three or more generations, even if it was not necessarily in continuous use, in the sense of year on year, and we can suppose that at least some neighbouring sites were used in the same way. People were without doubt recurrently present at this place. There is evidence for activities at different times of the year (which are also reviewed below by Bartosiewicz). Local cereal cultivation is highly probable, and very possibly with autumn rather than spring sowing; the maintenance of garden plots strongly implies permanent commitment and investment; and people must have been present in the summer for harvesting (Bogaard *et al.*, chapter 23). Animal and other remains may tell a similar story. Bones of young animals suggest summer occupation, as do also a host of bird remains, shellfish collected in spring and autumn, and fish bones (Bartosiewicz, chapters 14 and 20; Gál, chapter 19; Gulyás *et al.*, chapter 21; and see Pike-Tay *et al.* 2004). Winter occupation can be seen in the presence of winter residents among the bird species (Gál, chapter 19) and from the tooth sectioning data on caprines (Pike-Tay, chapter 16; Pike-Tay *et al.* 2004). In these traditional ways of spotting seasons and summing the result, occupation can be seen as year-round.

Should we be content with this characterisation? How confident are we that this picture applies to each and every year in which the deposits of the occupation accumulated, over three generations or so (cf. Milner 2005)? The evidence for occupation from spring to autumn is most abundant, and for winter much less so; that emphasis would be reinforced if spring rather than autumn sowing were the case, and even autumn sowing might not entail a sustained human presence right through the winter. Conversely, if autumn sowing is supported, the caprine tooth evidence for winter kill-off becomes striking and could suggest that this was the time when people were concentrated at the site for longer periods of time. The lack of caprine tooth evidence for summer kill-off has to be accommodated in our interpretations and strongly suggests to me that people came and went from this site, perhaps on a structured basis in tune with seasons and other rhythms such as flooding, but perhaps also in tune with social custom and preferences.

In summary, three positions are possible. First, the site was permanently occupied as the 'sedentary' base of a small population. Supporting this are the range of seasons indicated by the varied faunal, avian and molluscan evidence, the existence of structures, and the likely maintenance of small plots or gardens for cereal cultivation. Secondly, the site was in reality a palimpsest of different activities taking place in different ways and at different times (principally from spring to autumn) across a period of time long enough to allow a drift in habit and practice. Buildings and plots could be maintained for a while without tying a set number of people to the place (and the suggested smallness of the occupation hardly suggests an autonomous reproductive unit), and may have been left to lapse or decay from time to time. Opportunistic fishing and hunting trips in one year, episodic stays with herds in another, reaction to occasional big flood events in another, might all better characterise the flow of life in this place at this time. Thirdly, and drawing on aspects of both these other models, the place could be seen as a permanent feature of the landscape, in long but not necessarily continuous use, and with a finite history. It could be recognised by the presence of buildings, the hollows and undulations of pits at different stages of their lives, the textures of middens and other residues, and by smoke above it. People came and went from this place, and I will link their likely forays, shorter and longer, to a notion of taskscape in discussion below. In this model, people were both rooted and often on the move, and it is that conception of them that I prefer.

Before moving to wider discussion, further review of subsistence issues is in order, as the last part of our analysis of the significant technicalities raised by excavation of Ecsegfalva 23.

Making a living: further technicalities

László Bartosiewicz

This summary contribution, based on specialists' reports in this volume, is aimed at reviewing the animals used at the site of Ecsegfalva 23 by major groups, looking at their nutritional, seasonal and cognitive status in Neolithic life.

During an Early Neolithic climatic optimum, animal husbandry expanded northwards from the Balkans. This advance may be traced archaeologically, in particular along its northern frontier, in the variants of the Starčevo/Körös/Criş culture in Yugoslavia, Hungary and Romania respectively (Whittle *et al.* 2002). Some archaeozoological assemblages are similar to that of the pre-pottery Neolithic in Thessaly, although hunting, fishing and gathering complemented domestic animal resources to varying extents. *Sensu lato* the arrival of the Early Neolithic Körös culture meant the beginnings of food production in the Great Hungarian Plain. Owing to the strong presence of sheep and, to some extent goat, at many sites of this period the diffusion of these small ruminants with no wild ancestors in Europe is an indisputable fact. Whether animal keeping reached this region from the Balkans by demic or cultural diffusion remains an open question (and this is discussed further later in this chapter). Overwhelming reliance on domestic ruminants at all major Körös culture sites, however, seems to point beyond the simple, rapid adaptation of animal husbandry skills by a local Mesolithic population.

On the other hand, the Körös culture population itself seems to have shown considerable inertia in changing its 'Balkan' animal husbandry practices. In classical pastoral economies, the species composition of herds depends on the perception of environment: that is, the herders' perception of the best means of exploiting their habitats (Johnson 1969, 13). Meanwhile, as seems to have been the case with Körös culture pastoralists, traditional species preferences (in this case caprines) may be maintained even in less than ideal environments (Bartosiewicz and Choyke 1985, 183). The delicate balance between natural and cultural imperatives cannot be understood without familiarity with ecological conditions, possibly rooted in the experience of several generations.

Archaeozoological evidence from Ecsegfalva 23 suggests that early farmers at this site relied on exploiting a broad spectrum of animals in their environment. In addition to animal keeping, gathering, fishing, fowling and large game hunting also played, at least, a complementary role, sometimes on a seasonal basis, in the provisioning of animal foods as well as raw materials. Exploiting different animal classes involved specific techniques and thus the presence of various animal remains at archaeological sites represents a series of different responses to the natural environment.

The quality and quantity of animal foods

Although it is customary (and not incorrect) to refer to animals as sources of protein in the archaeozoological literature, empirically, it is the energy content of meat that may be perceived as nutritive value. While subtleties of amino acid composition would have been an unlikely concern to Neolithic people, fatty or filling meats must have been immediately recognised at the time of consumption. It may also be presumed that qualitative distinctions between various cuts were already important during prehistoric times, and that these were not simply related to the metabolic value of the meat concerned, but were also at least as laden with culturally idiosyncratic associations as today (Bartosiewicz 1997b). While individual chapters in this volume have been concerned with the quantification of various animal remains, a qualitative comparison between animal classes is worth reviewing here. Animal foodstuffs of potential significance at Ecsegfalva

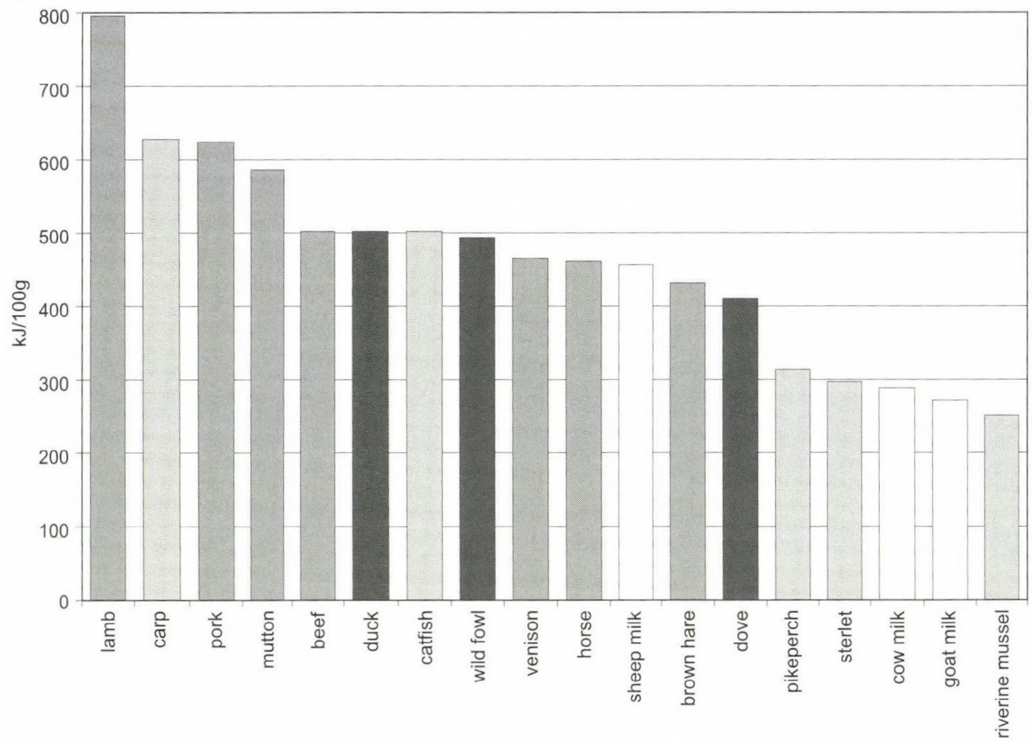


Fig. 32.1. The energy content of animal foods. Various animal classes are distinguished by shading

23 are ranked by energy content in *Fig. 32.1.* The same variable may be viewed in a seasonal context in *Table 32.1.*

Although refuse bone from settlements provides primary evidence of meat consumption, it is very important to point out that ratio values in *Table 32.1* should by no means be converted into absolute quantities using the archaeological material. Inaccurate dating and quantification bias make most estimations of absolute meat weights an indoor sport of doubtful academic merit. Aside from the decades of controversy surrounding the calculation of minimum numbers of individuals, differential taphonomic loss would heavily bias any such estimate, and the actual quantity of meat calculated for various animals would render most values incompatible with the others. The simple anatomy of bivalve shells and a fortunate, closed assemblage of their remains at Ecsegfalva 23 made such a reconstruction attempt relatively realistic (Gulyás *et al.*, chapter 21). In the disarticulated and mixed heaps of vertebrate skeletons, however, not even comparisons between fish and sheep would be meaningful in a quantitative sense. In order to speak of consumption in proper, numerical terms, the precise time interval of accumulation, and the number of people creating such deposits would also be indispensable variables. With both of these parameters missing, interpretations remain, to say the least, questionable. To put it simply: taking the daily *per capita* requirement of nutrients as a constant, the food remains left behind by two people over a ten-week period would not be possible to distinguish from those deposited by ten people in two weeks.

It is also fundamental to distinguish between animal keeping and the osteological evidence of meat consumption. Concentrated herds of caprines in the Near East have not been kept so much for meat but rather for secondary products and to be used as a trading currency by present day pastoralists (Akkermans 1990). Such ethnographic observations suggest that depending on the economic situation and cultural traditions, even the culling of prolific small stock may have been subject to serious consideration. Ethnohistorical data, therefore, offer a loose interpretive framework for the appraisal of meat provisioning. In the recent past, for example, Yürük sheep herding communities in Anatolia consumed meat only 3–4 times a year (Vékony 1997, 75).

Table 32.1. The energy contents of seasonal animal foods available to the inhabitants of Ecsegfalva 23 (after Koltai 1949, 74; Magyar and Petrányi 1956, 378–83, Gulyás *et al.*, chapter 21). The minimum values of modern domesticates may be most relevant to their Neolithic counterparts

100g	kJ	Seasonal availability
brown hare	431	all year round
horse*	461	all year round
venison	465	all year round
brain (cattle)	502	all year round
beef**	502–(1285)	all year round
mutton	586–(1297)	all year round
pork**	624–(1327)	all year round
bone marrow (cattle)	3559	all year round
annual mean	**891**	
riverine mussel	251	spring-fall
wild fowl	494	spring-fall
duck	502	spring-fall
spring-fall mean	**416**	
goat milk	272	spring–summer
sterlet	297	spring–summer
pikeperch	314	spring–summer
sheep milk	456	spring–summer
catfish	502	spring–summer
carp	628	spring–summer
lamb	796	spring–summer
spring–summer mean	**466**	
cow milk	**289**	Summer

*Horse stands in for wild ass in this list
**The minimum value taken for both the wild and domestic forms

Seasonality and mobility

Different types of seasonality data for riverine mussel, fish, birds and caprines suggest that, in general, spring to fall occupation as a background variable must have played a serious role in shaping the Ecsegfalva 23 animal bone assemblage. Important tooth sectioning data on caprines add late winter to this time interval (Pike-Tay, chapter 16; Pike-Tay *et al.* 2004). This seasonal pattern has been reconfirmed by the broader but less precise evidence of tooth eruption and long bone epiphyseal fusion in caprines. Among the bird remains, the presence of goosander, a winter visitor, is also indicative of the possibility of a year-round occupation (Gál, chapter 19).

The various parts of year when particular animals or their specific age groups could be exploited for food seem to overlap. In addition to the staple of meat provided largely by domesticates throughout the year, the summer half of the year and especially the spring and early summer offered a more varied protein diet. It is also noticeable, however, that these seasonal additions were relatively light foods in caloric terms (cf. *Table 32.1*). The evidence of incremental bands in shell sections points to summer gathering (Gulyás *et al.*, chapter 21), a time when milk would also have been available. Even without the possibility of comparing the quantities of different animal remains, it may be presumed that seasonal additions represented a relatively small portion of the animal protein diet, based chiefly on the culling of Ruminants at this site.

As for the seasonal mobility of both herds and people, ethnographic parallels show that parameters of modern transhumant migration would have permitted long distance, intensive movements. Up to the nineteenth century, large herds of sheep from the Carpathian mountains were regularly herded to the Great Hungarian Plain between October and late April (Bartosiewicz 1999c, 49). At Ecsegfalva, most dental microwear patterns in sheep and goat, suggestive of highly abrasive graze, are interpretable as a symptom of high stocking levels (Mainland, chapter 17). This may not only imply localised sheep or goat keeping, but is also indicative of an environment in which both cereal cultivation at the site (Bogaard *et al.*, chapter 23) and the marshy conditions beyond limited the extent of good graze at least during part of the year.

Historically documented migrations during the first millennium AD have shown that many eastern pastoral groups arriving in the territory of present day Hungary had their economic traditions initially disrupted, by being literally bogged down in the Carpathian Basin. It may thus be hypothesised that under this pressure, once they had conquered the Great Hungarian Plain, their pastoral winter occupations eventually turned into permanent habitations and the rate of sedentism accelerated (Bartosiewicz 2003a, 103–104). It is impossible to tell whether people of the Körös culture experienced the same challenge. It remains a fact, however, that the Ecsegfalva 23 region was very different from their traditional habitats.

Given the ample zoological evidence of summer and autumn occupation at the settlement (Bartosiewicz, chapters 14 and 20; Gál, chapter 19), it seems unlikely that the settlement would have been seasonally abandoned. The variety of crops probably cultivated in plots around the settlement (Bogaard *et al.*, chapter 23) would also have needed continuous care, even if one hypothesises a dispersal of human activity during the summer months over the broader landscape. For example, sheep and goat may have been kept in the broader vicinity of the site taking advantage of extended pasturage over harvested fields and drying flood plains (Mainland, chapter 17), possibly along the Holocene channel of the Berettyó river located north of the modern village.

Evidence of late summer mussel gathering in such an alluvial habitat (rather than the neighbouring Kiri-tó) was clearly recognisable in the material (Gulyás *et al.*, chapter 21). The species composition of fish remains, on the other hand, is more indicative of shallow, residual waters, possibly in the settlement's immediate proximity. Fish may have been most easily caught during the early summer spawning rush here, prior to the aforementioned late summer–autumn expansion into the settlement's hinterland. Sporadic remains of fish species with preferences for clear rivers (e.g. sterlet, barbel and pikeperch) may originate from individuals caught occasionally in the river channel, the same way mussels were collected. On the other hand, they may be of local origin as well, simply reflecting ecological variability and an overlap between the faunas of different aquatic habitats (Bartosiewicz, chapter 20).

With the exception of large, mature carp, most fish were hardly larger than hand size, including the estimated length of young pike. Fishing techniques selective for this size range may include gathering, trapping/potting or net fishing. However, no artifactual evidence of the latter was found aside from a number of perforated clay weights whose conventional interpretation as net sinkers remains questionable (Oross and Whittle, chapter 28).

Dairying

A special form of secondary exploitation related to seasonality is milk production, closely tied to the reproduction cycle which is especially tightly defined in unimproved domestic animals. At Ecsegfalva 23, evidence of lipids originating from Ruminants was found on 17% of the sherds sampled. In two cases, milk fats could be recognised, although the species in question could not be identified (Craig *et al.*, chapter 18). At this point, one can only speculate about the origins of milk. Sheep is a likely source as an animal that played an evidently central role in the Körös culture, and was also easier to handle than cattle. In addition, the energy content of sheep milk matches that of most meats, and is twice that of cow's or goat's milk (cf. *Table 32.1*). Indirectly, the unusual tooth microwear of one of the sheep, showing minimal soil ingestion, may be indicative of a penned individual selected for milking, although this single case may fall within the normal range of variation caused by individually different grazing habits (Mainland, chapter 17).

The relatively small size of sheep at Ecsegfalva 23 (Bartosiewicz, chapter 14), as well as at the more or less coeval settlement of Endrőd 119 (Bökönyi 1992a) may, in itself, be indicative of environmental stress in the new, humid habitat. Sporadically occurring arthritic deformations on the bones of these animals support this hypothesis at both sites. Under such circumstances reproduction, and lactation specifically, may have failed first.

The marshland of the Great Hungarian Plain was better suited for cattle keeping. The use of cow's milk cannot be ruled out either, since genetic evidence shows that domestic cattle arrived together with sheep and goat as agriculture dispersed into Europe (Bollongino *et al.* 2004). People of the Körös culture, therefore, may well have been familiar with milking cows.

The periods of lactation differ between small ruminants and cattle. Sheep and goat milk are available earlier, during the spring, while the later calving of cattle rather provides milk during the summer. Should both small and large Bovids have been exploited for milk, these two major lactation periods may have complemented each other (Dahl and Hjort 1976).

In any case, this early evidence of a sophisticated form of secondary exploitation may point to the role of demic diffusion in spreading such expertise during the Early Neolithic.

Attitudes to the non-domestic fauna

Wild animal remains, when available in considerable numbers, are often used in characterising the environment. Owing to the selective nature of hunting, however, they rather illustrate human decisions and techniques applied to the exploitation of wild resources, as seems to be the case at Ecsegfalva 23. The scarcity of wild animal bones among the food remains shows that inhabitants of the settlement *produced* most of the meat they consumed. Roughly speaking, when less than one quarter of NISP originates from game animals among the food refuse, one should not reckon with subsistence hunting at Neolithic sites (Bartosiewicz 1990b, 288).

When the seasonal availability of various sources of animal energy in the diet is considered *(Table 32.1)*, it is evident that animal keeping and, to some extent large game hunting, provided a massive supply of energy, and hence animal protein, throughout the year. One of the great achievements of domestication was that it multiplied and stabilised the number of large mammals constantly available for consumption; as opposed to hunter-gatherers, herders control a dependable source of meat.

In addition to this utilitarian approach, however, the life of hunters, often looked upon as more precarious by modern standards, represents an attitude to nature that is different from that of herders. This cognitive difference is often emphasised when Mesolithic and Neolithic ways of life are compared.

Given that the level of Early Neolithic agricultural activity at Ecsegfalva 23 may have been considered 'cutting edge' subsistence at the time, one may presume that people at this settlement did not always hunt by choice. A sheep herding, cereal cultivating community from the south seems to have ended up in a possibly hostile, marshy habitat ill-suited to its previous way of life which developed in the drier regions of the Near East and subsequently in the Balkans. Among others things, objects of stone and bone clearly interpretable as projectile points are virtually missing from the inventory of artefacts. Such objects would indirectly illustrate a more violent attitude to the natural or even social environment, depending on their interpretations as hunting gear or weapons of war (Choyke and Bartosiewicz 2004, 75). In addition, the relatively high percentage of wild animal bones in small Körös culture faunal assemblages often seems to be the product of insufficient sample size (Bartosiewicz, chapter 14).

One of the most important wild animals represented in the Ecsegfalva 23 assemblage was aurochs. The weight of bone fragments shows that aurochs contributed masses of meat to the diet. Remains of this large game animal were identified on the basis of phenotypic size. Aurochs populations across Europe are genetically distinct from domestic cattle, and DNA samples taken from large Bovine bones at Ecsegfalva 23 belong to the general wild form (Edwards and Bradley, chapter 15). Cross-breeding with domesticated cattle, hypothesised by Bökönyi (1974, 103) during the Late Neolithic solely on the basis of overlapping metric data, seems to have played no role at this early time.

The exact mode of aurochs hunting at Ecsegfalva 23, however, remains a question. On the basis of the attritional age profile for aurochs, even scavenging or at least preying selectively upon solitary and senile individuals have been hypothesised (Bartosiewicz, chapter 14). Alternatively, aurochs hunting may have been a rite of passage or reconfirmation of manhood for men in the community (Morris 1998, 71), although this hypothesis is impossible to test at Ecsegfalva 23. Considering the investment of time and energy required in comparison with herding, aurochs hunting may have been, to say the least, a labour-intensive activity (Whittle 2003, 90).

While the importance of aurochs hunting is shown by displays of magnificent horn cores during the Late Neolithic in Hungary (Bartosiewicz 1999e), the cognitive importance of this animal is only shown by some spoons and massive bone hooks, important types in the Körös culture, apparently related to the social identity of the owner. They seem to be made almost exclusively from large bovine (most probably aurochs) long bones in this region (Makkay 1990a).

The barely more than 100 remains of red and roe deer, in addition to no more than five unworked antler fragments from both species illustrate the negligible importance of venison in the diet. Deer antler, a malleable and easily available raw material, was, astonishingly, not manufactured at Ecsegfalva 23 (Choyke, chapter 29). This is surprising given the extensive use of antler as a raw material in Early Neolithic territories to the south. A possible environmental explanation for the scarcity of red deer remains may be that this species prefers denser woodland to more open, marshy habitats (Hüster-Plogmann *et al.* 1999). On the other hand, the cognitive/symbolic significance of stags in the Körös culture is shown by representations of this majestic game on pottery, as well as by at least one complete antler rack found in a clear ritual context at the site of Szarvas 23 (Makkay 1990a, 23). A distant parallel to this discrepancy was observed at the site of Shahr-i Sokhta (Eastern Iran), where the remains of sheep and goat overwhelmingly dominated the archaeozoological assemblage, with a single pig bone present among several thousands of identifiable specimens. Meanwhile pig was a commonly occurring motif among clay figurines at that site (Bökönyi and Bartosiewicz 2000). In any case, the apparently three-pronged antler rack shown on a stag motif depicted on a Körös style sherd from Csépa *(Fig. 32.2)* may show little familiarity or concern with the actual anatomy of this possibly mythical animal itself (Clive Bonsall, *pers. comm.*).

Pig bones, identified as originating from the domestic form, represent a different group of animals that may have been domesticated locally across Europe, as has been demonstrated by the analyses of ancient DNA (Larson *et al.* 2004). The marshy environment of Ecsegfalva 23 was an ideal habitat for both wild and domestic pig. It is therefore curious that domestic pig was very poorly represented among the food remains. A tradition-driven preference for mutton, a lack of boar hunting and initial attempts at local pig domestication may be cited as possible reasons for the scarcity of Suid bones. Tentative distinctions between the bones of domestic (NISP = 82, 1.4%) and wild pig (NISP = 34, 0.6%) could be made on the basis of size only. Owing to their transitional position and marginal role in Körös culture animal keeping, pigs may have fallen closer to wild animals in the Neolithic imagery of Ecsegfalva 23. In spite of its modest representation among food remains, domestic pig, therefore, must have had a curious if not respectable position, linking the wild

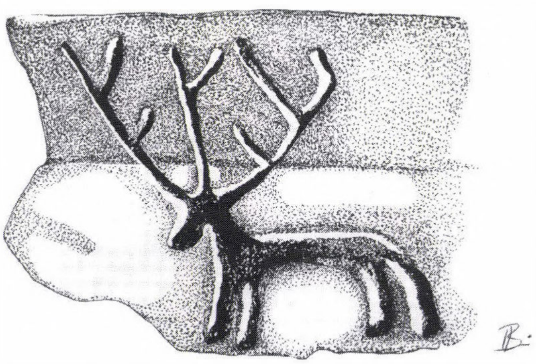


Fig. 32.2. The deer from Csépa

and domestic sphere in a presumably pastoral community. Herding almost semi-feral pigs was a booming early capitalist enterprise in the woodlands of Central Serbia (Halpern 1999). Around the settlement pigs, similarly to Neolithic 'pariah' dogs (Bartosiewicz 2002b), may have been simple scavengers coexisting with the human community, often in urban settlements. That situation, however, would have been different from the Early Neolithic scenario at Ecsegfalva 23, since it would have required a far greater concentration of pigs and, above all, people (Bartosiewicz 2003b) than may be reconstructed from the meagre remains of pig recovered at this rural hamlet.

Birds of all sorts must have been ubiquitous in the settlement's environment. The 276 identifiable bird bones yielded 52 taxa. This great variety of species relative to the small number of identifiable bones in this assemblage seems to be indicative of opportunistic fowling. Some of the birds may also have been targeted for their feathers (Gál, chapter 19). Animal foods, seasonal in nature (such as mussels, fish and birds), also represent smaller concentrations of energy (cf. *Table 32.1*) which, in qualitative terms, falls in line with the hypothesis of opportunistically exploiting these animal resources as a complementary element in the diet.

Social aspects of the procurement and consumption of animal foods

Attitudes toward animals, both wild and domestic, probably varied within Körös culture society depending on the species and may well have been manifested in the division of labour related to producing, harvesting and consuming animal products. On the basis of ethnographic analogy, gathering riverine bivalve shell and catching small fish in the shallow waters located within the settlement's immediate environment may have been an activity in which women, children and the elderly were engaged. On the other hand, large game hunting, especially that of the powerful and dangerous aurochs and similarly dangerous wild boar, is usually associated with male prowess. An over-emphasis on aurochs hunting could actually introduce an androcentric bias in evaluating the first pastoral societies of the Great Hungarian Plain.

Gender- and age-related roles are more difficult to appraise in pastoralism. Tending small stock, characteristically sheep, certainly did not take a warrior's strength or status, and may thus have been equally practised by men, women and children. The same holds true for fowling, especially when its aforementioned opportunistic nature noted at Ecsegfalva 23 is taken into consideration. Catching some birds may have taken more skill than others, which meant that they were available to different segments of the human community. Similarly, small game such as hare may have been caught by just about anyone who was shrewd or swift enough to compete with these animals. They may even have been regarded as pests encountered by people, possibly women, tending the crops and killed opportunistically.

However, as Miracle (2002) has pointed out, identifying such differences from the archaeological record can be problematic if not impossible. Nevertheless, recognising elements of a division of labour would be all the more important in trying to establish idiosyncratic patterned differences between Mesolithic and Neolithic subsistence traditions. Hunting versus animal keeping probably mobilised the two populations in different ways. This difference, together with that in the attitudes toward animals may have resulted in contrasting world views that would be instrumental in better understanding the economic and social transformation brought about by 'Neolithisation' in this part of Europe.

Whoever the first herders at Ecsegfalva 23 were, their status and economic well being were prone to perpetual, dynamic change. Among the hypotheses mooted, hunters taking over stock breeding would have been the more radical possibility. However, putative immigrant pastoralists from the Balkans did not have it easy either. According to a modern ethnographic parallel, nineteenth-century Russian settlers in the Caucasus adopted local transhumance techniques, determined by topography and climate, in less than two generations. However, they did not give up sedentary cattle breeding, different from indigenous semi-nomadic sheep keeping traditions (Yamskov 1988, 6–7). While this situation is almost the diametric opposite of what has been studied in this contribution, it clearly shows the conservative nature of animal husbandry. Similarly conservative food habits may somewhat over-emphasise such patterns when settlement refuse (i.e. direct evidence of meat consumption) is studied.

Animal exploitation at Ecsegfalva 23 in diachronic context

Finally, animal exploitation at Ecsegfalva may be reviewed against the background of NISP data for the most commonly encountered Neolithic mammals from 54 sites published in the literature (Bökönyi 1959, 1964; 1969; 1974; 1981; 1984a; 1984b; 1985b; 1987; 1988; 1992a; 1992b; Clason 1980; Vörös 1980; 1994; 1996; 1997; Bartosiewicz 1984; 1994; 1999a; Bartosiewicz *et al.* 1995; Bökönyi and Bartosiewicz 1998; Schwartz 1998; 2002). These assemblages have been pooled into the three gross periods, of the Early (22 sites), Middle (20 sites) and Late (12 sites) Neolithic. Domesticates entered into this calculation included cattle, caprines, pig and dog. Large game were represented by the remains of red deer, roe deer, aurochs and wild pig. Unfortunately, only scarce comparative material would have been available for special taxa recovered from the water-sieved Ecsegfalva 23 assemblage: fish, bird and even bivalve shells.

NISP values from the 54 sites were entered into a stepwise discriminant analysis aimed at testing the hypothesis that the composition of assemblages changed during the Neolithic in statistically demonstrable terms. In order to reduce the heteroscedasticity of data, that is, to balance differences sometimes of several orders of magnitude between assemblages, the decimal logarithms of NISP values were used.

First, animal taxa were ranked by their potential of characterising differences between the three chronological groups. Less characteristic animals were removed from the calculations on the basis of their F-values during this stepwise procedure *(Table 32.2).*

The overall distinction between Early, Middle and Late Neolithic assemblages is best expressed in the contribution of pig bones to various assemblages, which is remarkably small at settlements of the Early Neolithic Körös culture. Sheep/goat provided the next group of animal remains of great discriminatory value. The rest of the animal species could not be used in distinguishing between periods, either owing to their consistently high (most notably cattle) or consistently low (e.g. dog) representation in all assemblages, regardless of chronological classification.

Table 32.2. Parameters of ranking major Neolithic meat providing animals by diachronic discriminatory value in 54 assemblages

	Wilks' Lambda	Partial Lambda	F to remove = 2.444	P level
pig	0.372	0.594	15.064	*0.000*
caprine	0.298	0.741	7.695	*0.001*
aurochs	0.262	0.843	4.101	*0.023*
wild pig	0.243	0.910	2.169	0.126
roe deer	0.239	0.924	1.800	0.177
cattle	0.237	0.931	1.622	0.209
red deer	0.237	0.932	1.614	0.211
dog	0.228	0.967	0.742	0.482

Mean NISP values for the first three taxa of statistically significant discriminatory value are shown in *Fig. 32.3.* Trends shown in this graph are significant in formal statistical terms for all animal taxa discussed here ($Chi^2 = 29{,}184.9$, $df = 20$, $P \leq 0.000$). The steady, diachronic increase in the contribution of pig is by far the most marked phenomenon. This is matched by a relatively dramatic drop in the number of sheep/goat bones following the Early Neolithic. Pig keeping would have been an ideal way of exploiting the marshy floodplains of the Körös culture distribution area. Pigs need a

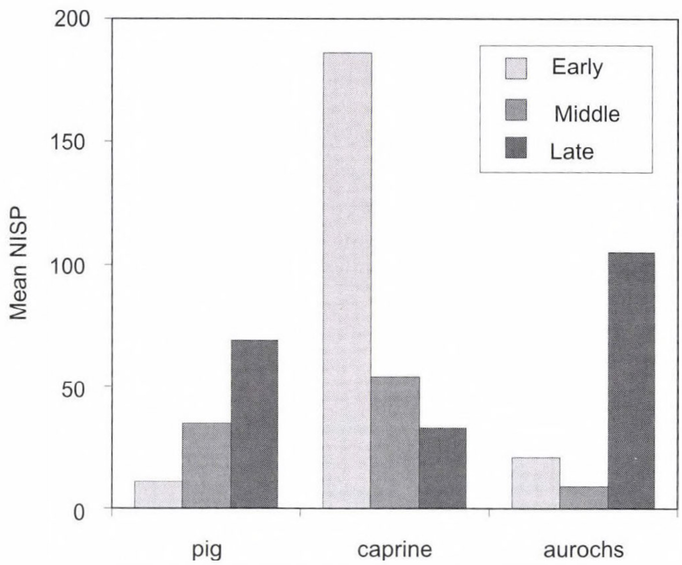


Fig. 32.3. Mean NISP values of the animals of most chronological discriminatory value

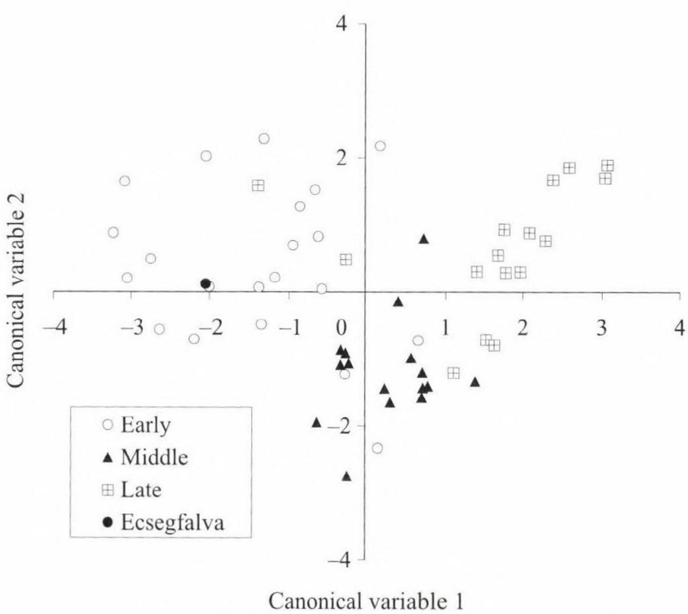


Fig. 32.4. The grouping of Neolithic assemblages by animal species

Table 32.4. Matrix showing the correspondence between chronological (predicted, columns) and faunal (observed, rows) classifications

Observed	Predicted				Percent correct
	Early	Middle	Late	Total	
Early	18	3	1	22	81.8
Middle	0	15	1	16	93.8
Late	2	3	11	16	68.8
Total	20	21	13	54	81.5

Table 32.3. Discriminant functions used in the distinction between Early, Middle and Late Neolithic faunal assemblages

	Coefficient 1	Coefficient 2
cattle	–0.776	–1.025
caprine	–1.214	0.363
pig	1.949	–0.763
dog	–0.471	–0.363
red deer	–0.454	0.780
roe deer	–0.793	–0.206
aurochs	1.040	0.803
wild pig	0.814	0.739
constant	0.579	0.212
eigenvalue	1.758	0.642

lot of water, and the rhizomes of reed are among the most favoured staple for wild boar (Faragó 2002, 368). The preponderance of caprines during the Körös culture may only be explained by a strong cultural preference for these animals, most probably rooted in tradition. In fact, the relative contribution of sheep and/or goat demonstrably declined during the rest of the Neolithic in Hungary (Bartosiewicz 2005, 60, fig. 6.9).

Most interestingly from the viewpoint of Ecsegfalva 23, the contribution of aurochs bones decreased by the Middle Neolithic, but rocketed in many Late Neolithic assemblages, especially from tell sites in the Great Hungarian Plain. This was the time period when Bökönyi (1974, 103) postulated that a secondary 'domestication fever' of cattle took place in the Carpathian Basin, although DNA tests have not yet supported this hypothesis. The remains of other large game (red and roe deer, wild pig) show the same diachronic pattern but much less markedly. It is possible that, at the beginning, newly arrived Körös culture pastoral settlers were probably eager to protect their domestic stocks, in what they may have perceived as an unknown, hostile environment. On the other hand, late Neolithic communities must have perceived the environment as a special challenge that had to be skilfully tackled every day.

In the next phase of calculations discriminant functions were computed, whose parameters may be used in classifying assemblages of unknown chronological affiliation into one of the three Neolithic periods on the basis of their logNISP values.

Individual assemblages grouped by these parameters are plotted by their relation to the first two canonical variables describing the relationship between chronological grouping and faunal content in *Fig. 32.4*. This graph shows a rather clear separation of Early Neolithic sites from the Great Hungarian Plain, that also includes a late component from the site of Karanovo (Bulgaria) on the basis of its very similar faunal composition.

The distribution of assemblages in *Fig. 32.4* may be expressed in terms of outliers, i.e. assemblages that did not fit their designated chronological period. Since, on average, 82% of the chronological classifications were supported by archaeozoological evidence *(Table 32.4)*, the hypothesis of diachronic change in animal exploitation practices may be accepted.

In the case of early sites of most interest here, Alföld Linear Pottery Culture (AVK) assemblages were classified with later periods owing to their greater contributions of pig remains. The least successfully re-classified group of late Neolithic sites contained two faunal assemblages from the Balkans whose faunal composition was most similar to early settlements in the Great Hungarian Plain.

Conclusions

Although the overwhelming majority of animal foodstuffs identifiable at Ecsegfalva 23 originated from domesticates, the rich faunal assemblage from the site reveals a varied attitude to different classes of animals. Aside from meat, the milk of Bovids was consumed, adding yet another seasonally available form of nutrients to those procured by the exploitation of aquatic resources in the site's alluvial environment. Opportunistic fowling contributed a great variety of birds to the diet. Although quantities of meat were acquired by hunting large game, especially aurochs, killing such beasts must have been a relatively rare occasion, possibly related to male identity and group solidarity. A predominantly pastoral way of life may be reconstructed from the animal remains. Although the backbone of this economy, sheep herding, did not seem too successful in the marshy environment, insistence on keeping these animals may be yet another indication that they were actually taken here by a new human population that colonised the Great Hungarian Plain from the direction of the Balkans.

The discriminant analysis of 54 Neolithic faunal assemblages has shown the immense significance which sheep and goat had during the Early Neolithic period. Eighty-one percent of the 22 early sites reflected this tendency. A special trait of the Ecsegfalva 23 assemblage, however, is that it offered an opportunity to study a full range of non-mammalian remains, in addition to the main trend recognised using discriminant analysis.

The performance of a lifetime: conviviality, choreography and connections in the Körös culture taskscape

So far, we have considered what I have called technicalities of existence at Ecsegfalva 23 and elsewhere in the Körös culture. That is not to denigrate their importance. But we can go even further, to enlist these issues in the pursuit of a wider view of life in this place at this time. We can engender a sense of layers of experience, from close focus on the immediate and local to active attention to things past, future and more distant, while also taking account of the values and motivations that underpin the ceremonial performance of social life. This is not just an added theoretical flourish; the clues are abundant in the technicalities so far reviewed, for choice, for engagement in the tasks of daily life, for response to the challenges of skilfully managing the environment, for a distinctive style of living. But some theoretical perspectives may help to draw these clues out further.

Elsewhere, I have already stated my view that agency and a dwelling perspective are the inescapable starting points for an interpretive archaeology of this kind (Whittle 2003; 2004; 2005). It is hard to disagree at a general level with John Barrett, as prominent exponent of an agency perspective, when he declares (Barrett 2001, 141), 'Agency is the means by which things are achieved...human agency operates knowledgeably and reflexively [...] Agents do not appear upon the historical stage as a given, rather they make themselves within and through their own specific social and cultural conditions'. The bleak and theoretically pointless alternative is to proceed 'as if the extinct social totality could be conceived of as a series of rooms which existed whether or not they were inhabited' (Barrett 2001, 147).

This agency perspective, which further emphasises that 'practice draws upon memory, past experience, expectations and desires, and a communicative engagement with other co-inhabitants (Barrett 2001, 152), is based fundamentally on the theories of Bourdieu and Giddens. It can be usefully united with the dwelling perspective, developed out of the phenomenology of Husserl, Heidegger and Merleau-Ponty. As expressed by Tim Ingold (2000, 200), '[...] in dwelling in the world, we do not act *upon* it, or do things *to* it, rather we move along *with* it. Our actions do not transform the world, they are part and parcel of the world's transforming itself. And that is just another way of saying that they belong to time'. The temporality of the landscape embraces a totality of rhythmic phenomena (Ingold 2000, 200). But even landscape may be too distanced a concept, and the idea of the taskscape emphasises people's engagement with their surroundings, with others, and with the ensemble of tasks with which they are continuously concerned (Ingold 2000, chapter 11, especially 195). 'The landscape is the congealed form of the taskscape [...] the landscape seems to be what we *see* around us, whereas the taskscape is what we *hear*' (Ingold 2000, 199, original emphases).

As I have argued elsewhere (Whittle 2003), these important approaches are nonetheless still lacking. Both risk being essentialist and universalised theories, applicable to all times and places. Neither gives any detailed sense in particular archaeological cases of what makes people want to go on, what motivates or guides them in terms of shared ideas and values, and both largely fail to explore the form or style within which social existence is carried out or which social existence creates, despite some emphasis being given by Ingold to the notion of performance (Ingold 2000, 198). Neither really deals adequately with situations of radical change, when both structural conditions and structuring principles (Barrett 2000) alter. So I want to draw on a mixture of other approaches, to begin to develop a way of thinking further about such issues.

One approach, grounded in current social anthropology, is a rewarding way of considering the creation and practice of social values in a daily social existence which nonetheless goes beyond the immediate present. This is the idea of conviviality or the art of living well together (Overing and Passes 2000a; 2000b; Overing 2003; see Whittle 2005 for a first archaeological application). Another idea, also derived from current social anthropology, is that of the choreography, or ceremonial form, of social existence (James 2003). Life has to be performed, and there is a flow or pattern to this performance. I do not want just to drop these concepts, based on the study of people elsewhere, on to the evidence for existence in the Körös culture, so I will also introduce the idea of connection and exchange (Whittle 2004), and that will also enable the taskscape to be brought back into the discussion.

In an important consideration of Amazonian social existence and sense of community, Joanna Overing and Alan Passes have drawn attention to an aesthetics of action, 'styles of everyday relating that are morally – and therefore aesthetically – not only proper but beautiful and pleasing' (Overing and Passes 2000a, xii). They use the term conviviality to connote living together and sharing the same life, grounded in:

> 'peacefulness, high morale and high affectivity, a metaphysics of human and non-human interconnectedness, a stress on kinship, good gifting-sharing, work relations and dialogue, a propensity for the informal and performative as against the formal and institutional, and intense ethical and aesthetic valuing of sociable sociality' (Overing and Passes 2000a, xiii–xiv).

In this vocabulary, love can be defined as 'practices, notions and feelings relating to everyday communal life and, in particular, some of the different ways of constructing, experiencing and embodying it' (Overing and Passes 2000a, xi). Further, 'Amazonian people [...] often gauge the success of sociality according to the degree of intimacy and informality, and the extent to which conviviality has been attained [...] a person's place within a social network of relations is judged by what they do and how they act, rather than in terms of prescribed roles and statuses' (Overing and Passes 2000a, xi–xii).

Already, important themes with wider implications emerge. Daily life is emphasised, with its constant detailed tasks and intimacies, along with informal but recurrent performance (see also de Certeau 1988). Explicitly, there is a revaluing of domestic life, which is often seen – in both anthropological and archaeological narratives – as a locus of much less importance than power politics or hierarchical and institutional rivalry (Overing and Passes 2000b, 3 and 9; Overing 2003). Attention is given to emotion and the affective side of sociality, which has largely been ignored including in recent attempts to characterise different forms of personhood and identity (e.g. Whittle 2003; Fowler 2004).

While there is much emphasis on harmony and love, the intensity of attachment to such an aesthetic of living also explains the converse of dispute and anger, and the fragility of affective community (Overing and Passes 2000b, 20–23; and see also Alès 2000; Gow 2000; Rivière 2000). 'The distinctive feature of Amazonian social talk is that it pertains to a language of affect and intimacy that *conjoins thinking and the sensual life*, where the concern is with the attributes of the everyday moral agent in ordinary interpersonal pursuits', and 'it is a language that speaks axiologically of the social benefits of the practice of the everyday virtues of love, care, compassion, generosity and the spirit of sharing' (Overing and Passes 2000b, 3). However, such language 'dwells equally upon the antisocial inclinations of anger, hate, greed and jealousy that are disruptive to the human social state' (Overing and Passes 2000b, 3). Moreover, the human sociable world is often understood as surrounded by a violent, angry, ugly and capricious universe (Overing and Passes 2000b, 6–7)

Using reflections on the recent and current ethnographies of a different continent is not to produce a new checklist for investigation of a different time and place. Manifestly the Great Hungarian Plain in the early sixth millennium cal BC was not Amazonia as it has been encountered by current and recent anthropologists. Whether people of the early sixth millennium cal BC on the Great Hungarian Plain thought of their cosmos as malignant is an open question. And there is clearly variation within Amazonia, where, to take just two examples, the daily interactions of the Pa'ikwené are normally jovial and raucous, in contrast to the quiet-loving Trio, who 'lexically distinguish two states of sociality, the euphoric once-in-a-while festive and the daily calm, tranquil style of the everyday, where noise is kept at a very low level' (Overing and Passes 2000b, 15). But the value of a comparative approach remains. Pointing up the difference of approach explicit and implicit in other models helps to formulate a general theory of how people experienced living together; social existence, 'convivial intimacy' (Overing and Passes 2000b, 7), is foregrounded, and one that has multiple dimensions. In an anthropology of the everyday 'where the moral virtues and aesthetics of interpersonal relations, not structure, are the overriding concern' (Overing and Passes 2000b, 7), we have the chance to encounter 'the life of experience, of laughing and crying, of loving and hating, of caring and feeding [...] the talking, chatting and telling, the singing and playing, the laughter in work, the tact and aesthetics of interpersonal dealings', the features of performed daily life which seem to take up most of the time and energy of Amazonian peoples (Overing and Passes 2000b, 9). As archaeologists, we may hear comparatively little of the sounds of this taskscape, but the challenge is to at least listen for them.

The 'emotive impact of community, the capacity for empathy and affinity' has been recognised in other, more sociological studies (e.g. Amit 2002), and this should encourage us that the Amazonian example is far from isolated. Amit has stressed (2002, 18) that 'people care because they associate the idea of community with people they know, with whom they have shared experiences, activities, places and/or histories', and emphasises 'the essential contingency of community, its participants' sense that it is fragile, changing, partial and only one of a number of competing attachments or alternative possibilities for affiliation'. This, it can be noted, goes far beyond, though it is not incompatible with, the more limited notion of co-presence, an intimate gathering of different agencies (Barrett and Fewster 2000, 30–31).

Evoking Mauss, Wendy James has drawn renewed attention to the idea of the morphology of social events, and more generally to the choreography of social existence, social form in movement, and its deeply ceremonial character (James 2003, 4–5). This serves radically to break down any supposed distinctions between the mundane and the special, or between the profane and the sacred. Her suggested examples range through religious occasions and public ceremonies to the patterning of daily work and family meals; the flow of traffic in the city is one example of patterned but fluid choreography (James 2003, 91). She quotes Alfred Gell on the Maori meeting house as movement of thought, movement of memory and movement of aspiration (James 2003, 99; Gell 1998, 257). This idea is potentially powerful. It builds on the temporality of the landscape and gives form to the notion of attentive engagement in the taskscape. It evokes, through the metaphor of choreography and dance, a dynamic collectivity of action, individual agencies in context and in relation to others.

What I am trying to evoke, therefore, is a sense, first, not only of people acting in the world, with which they are fully engaged – the agency and dwelling perspectives – but of the motivations and values which keep small-scale societies turning over, and indeed bring them into existence, and secondly, of the flow or pattern of the affective sociality which constitutes their daily existence. Difference between small-scale societies may rest not only in the nature of their socialities, their conviviality, but also in the form of their interactions, its choreography.

At this point I want to tack back to the technicalities of existence in and around Ecsegfalva 23. This site and others in its world seem concerned with the flow of daily life. The site residues are largely mundane, resulting from acts of burning, preparation, eating, defecation, digging, and so on. There are no special buildings (as far as we can tell given the limitations of the excavations) and relatively few special or unusual artefacts. It may even evoke that unexotic, unremarkable and boring domestic field so often ignored by anthropologists (Overing and Passes 2000b, 9). But can we not hear something of its rhythms and flows? We can evoke the choice of position beside the great meander, the respect shown for the earth by digging pits into it and eventually returning its material to them, the modest if not limited impact made on the local surroundings, and the selective use of wild resources including sparing use of red deer and aurochs. We can summon the choice, habitual perhaps but more or less consciously maintained, to inhabit chosen places in small social groups, at distances from neighbours but not completely removed from them. We can imagine the skilful attention given to the ensemble of daily tasks, from the patient tending of gardens and the steady moving of flocks of sheep to the occasional opportunistic capture of small game, birds or fish. We are confronted with the skills and knowledge required to go on, to do things in the right way: these shellfish from the slow waters, those from the swifter ones; or awareness of when all the waters might begin to rise. (In his study of people living beside the Amazon, Mark Harris has drawn attention to the inherent importance of the rise and fall of the waters of the river for the rhythms of life (Harris 2000). The state of the river conditions sociality. In the flood season, people are largely confined to their houses, a phase of low spirits and reflection, but also a time for the maintenance and repair of familial and other close social ties. As the waters recede, so people can begin again to move more freely, and a season of aggregation for festivals and other gatherings begins, a period of high spirits and elevated mood, but also one eventually of tension and conflict.) I was struck by the visual impression of the great litter of material in the excavated portion of Ecsegfalva 23 since the very first opening of our Trench 23B, and I want to think of this materiality not only as a visual signal, a texture redolent of a particular human presence, but as symbol of sociality and occasional gregariousness focused round the provision of food and drink. Perhaps that took place in different ways and at different times, changing the composition of the residents, altering and lifting the mood, either at dark, slow moments in winter, when sheep would be slaughtered and feasted upon, or at perhaps predictable moments when floods rose and then fell, causing flurries of excitement and activity, and then leaving a bountiful residue of fish.

All these things seem to have taken up much of the time and energy of Körös culture people in their daily existence around and within the orbit of their occupations. Whether or not we can hear whether voices were raised or quiet, raucous or restrained, there is surely an aesthetic of living at work here too, performed in a fluid pattern, and with chosen places acting as the fixed positions in a dynamic choreography. I find it hard to resist the notions of intimacy, informality, general peacefulness and generosity, and of the steady flow of life. Issues of sedentism and mobility seem rather less important from this perspective.

This does not exhaust the possible characterisation of life in the Körös culture world. We should think also about that part of the taskscape that took people further afield, and about the dead, the past and origins, and a sense of tradition. A sense of connections or connectedness may link these varied fields.

As we have seen in chapters above (and see Whittle 2004), people who used Ecsegfalva 23 and other sites like it acquired lithic raw materials from considerable distances, in practically every direction: Carpathian obsidian from the north-east, limnoquartzites from the north, Szentgál radiolarite from the west, hornfels and dolerites from east (or possibly west), and Banat flint from the south. There was even a piece of Prut flint, yet more exotic (Mateiciucová, chapter 31). While there is much that we do not understand about wider relations with other people to the north, obsidian, limnoquarzite and radiolarite must have surely come in this situation from various Mesolithic contexts, the former two from the foragers who may be presumed to have co-existed with the Körös culture to its north, largely around the fringes of the Carpathian Basin rather than within it. Movement across the northern part of the Great Hungarian Plain may have been through a largely little used region (though the most recent discoveries of Körös culture sites further up the Tisza may require that model to be rather radically refined: László Domboróczki and Pál Raczky, *pers. comm.*). Szentgál radiolarite may also be presumed to have come from a forager context (Mateiciucová 2001), though just beyond the known limits of Starčevo culture settlement in Transdanubia south of Lake Balaton (Bánffy 2004; Kalicz *et al.* 1998). The hills of western Romania were within the general orbit of the Criş culture, and the Banat firmly within the main area of the Starčevo culture.

We cannot know in detail who procured or delivered what. The fact of pre-forms only tells us that whoever did the carrying sensibly cut down weight. Exchange networks, which the abundance of other raw material movements in the Körös culture world (Kaczanowska *et al.* 1981; Starnini 1995–96; 2000; 2001) strongly suggests, may have meant that no one person necessarily had to go the whole distance to each raw material source. Inna Mateiciucová has identified both

'Danubian' and 'Mediterranean' traditions in the treatment of flint at Ecsegfalva 23 and elsewhere (chapter 31), which may have something to do with the mixture of contacts and people on the move. But it seems unlikely that all the raw material at a site like Ecsegfalva 23 was brought to it by outsiders. These were people connected and on the move. Some might have gone periodically the 150–160 km north-east to the obsidian sources, and even if they sat on their hands beside the Kiri-tó they would still have been indirectly in touch with a much wider world.

The diversity of this contact seems much more than the result of technical needs for lithic raw material supply. There might have been a flow of other exchanges: of protein and carbohydrates; fur, feather and shells; and even of people as alliance and marriage partners. The ability to move and prowess in voyaging and negotiating may have also have been a facet of identity in the Körös culture world. It is extraordinarily unlikely that these exchanges of materials were neutral, or without implications for the constitution and reconstitution of the individuals concerned. In conducting relationships of exchange, it has been argued that the Maneo of eastern Indonesia are concerned for the response of others (Hagen 1999). Exchange among them is complex and important, objects circulating especially as marriage payments. Sociality in the sense of giving attention to others can be seen as an important factor. A disposition to generosity and an emphasis on expressing collective virtues by doing things openly have been part of Maneo sociality (Hagen 1999, 366, 372). 'Moral sensibilities inform Maneo efforts to shape perceptions of actions and events precisely as a way to induce responsiveness and to mitigate the appearance of unresponsiveness' (Hagen 1999, 362). It has also been argued that the emotional correlates of giving and receiving should be considered, through the case study of the Rauto people of coastal south-west New Britain in Melanesia (Maschio 1998). Among them, the gift is something corporate, an important part of collective social time, linking the living and the dead. Identity is acquired through a 'narrative of exchange', which involves and evokes memory, emotion, custom and obligation. The person is contributed to by others, including through gifts; 'persons are created by the gifts of others' (Maschio 1998, 85–86, 96).

Arguing from the diachronic pattern of representations of human form, principally on figurines – which is obviously a risky procedure – I have argued elsewhere for a sense of unfixed, somewhat ambiguous or slippery male personal identity in the Körös culture (Whittle 1998; 2001b; 2003; cf. Bailey 2005), and the apparent under-representation of males in burials on Körös culture settlements (Trogmayer 1969; Chapman 1994) could be consistent with a conception of the male as partly belonging to 'out there', to realms beyond the domestic. Recent discussions of personhood (Whittle 1998; 2001b; 2003; Fowler 2004) have stressed the frequent fluidity of the self, and emphasised that identity and gender are often performative and relational; the individual may be constituted in a web of relations and interchanges with others. This is not the place to rehearse all the supporting arguments, but this perspective may serve to broaden our view of the wider connections which may have lain alongside the technical procurement of raw materials in the Körös culture world.

One illustration of what I have in mind comes from the Foi of Papua New Guinea, whose lives are permeated by a sense of flow. James Weiner has written strikingly about the way in which among the Foi, women interrupt the talk of men, calling, commenting and interrupting from their smaller houses which flank the longhouse, where the men reside and also sleep, when they are all together in their central settlement (Weiner 1988; 1991, 5). The people are not always together. In the drier half of the year, people are congregated in the central settlement, focused on both gardening and communal life based around the longhouse, with its attendant emphasis on 'gregariousness, competitiveness and confrontation' (Weiner 1991, 8). Public life in the longhouse collective is contrasted with the intimate sociality of the bush-house, never more than an hour away (Weiner 1988, 38), in which the smaller unit of man and wife and immediate family work closely in complementary ways to achieve their own production goals. The wetter season of the year was associated with dispersal, especially to remote and isolated hunting lodges, and men's experiences in this domain constituted much of the stuff of talk back in the longhouse (Weiner 1991, 35). The Foi orientate themselves partly with reference to the flow of the rivers along whose banks they garden, and they make sense of life in their songs and their myths by reference to ideas of flow and movement.

Other senses of connection can be suggested, with the past, surroundings and animals. These serve to take us back again into the more immediate taskscape. Bartosiewicz has emphasised above in this chapter how sheep-keeping appears a less than rational adaptation to the conditions of the Great Hungarian Plain in the early sixth millennium cal BC, and has stressed the likely sense of tradition linked to a past in the south (I will also discuss origins further below). I have suggested elsewhere (Whittle 2003; 2004) that sheep by their movement and sounds could have more or less constantly provided their owners with visible and audible reminders of one dimension of the past, as well as serving as a metaphor for cohesion and togetherness. Mythic relations with deer, and the uncertain status of aurochs, have also been discussed above by László Bartosiewicz. And we can return finally to pit digging and demonstrable connections with the earth. Some kind of duality between earth and water, dry and wet, might have been one of the basic nodes of thought (cf. Bloch 1998) with which people in the Körös culture formed their view of the world. People at this time can be defined, as well as by their relationships with domesticated animals and plants and by their use of pottery, by their repeated and very direct use of material from the earth.

I have deliberately raised more questions in this section than we can possibly answer in the present state of research. But I want at least to think about the implications of our carefully collected and analysed data, and to reflect on the combinations of evidence for the ensemble of tasks in the daily landscape on the one hand, and less frequent, more dramatic, longer-range movements and exchanges of non-local raw materials on the other. I have suggested that we can

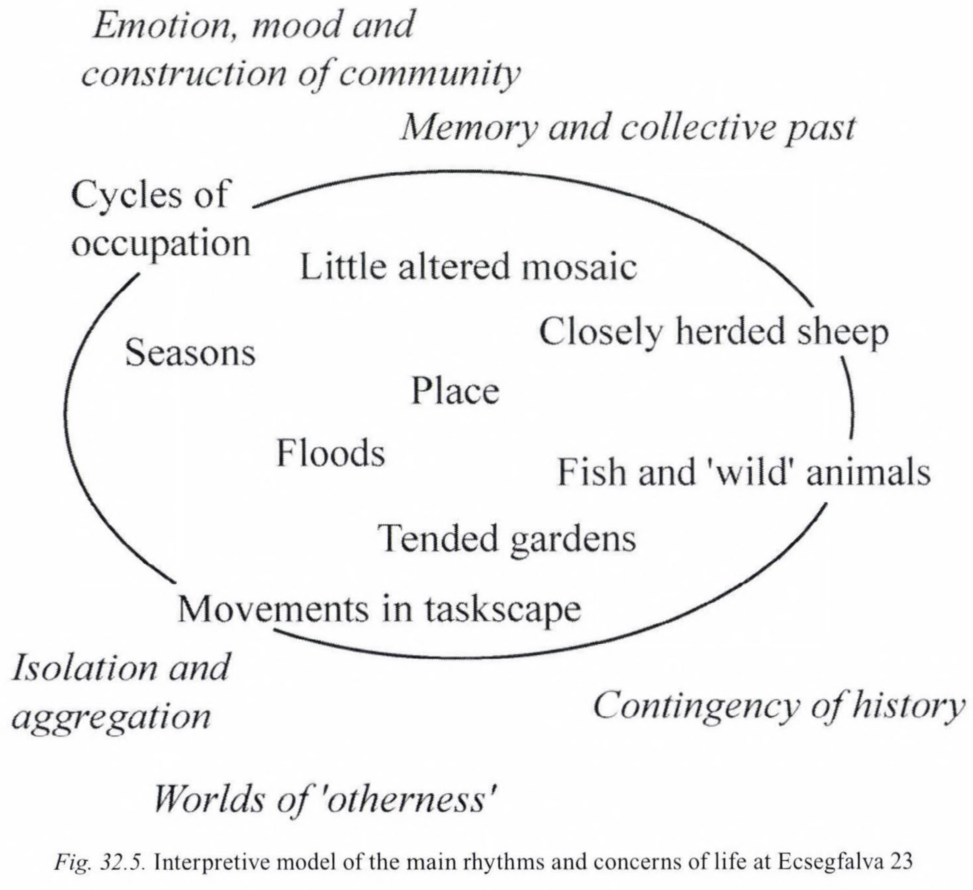


Fig. 32.5. Interpretive model of the main rhythms and concerns of life at Ecsegfalva 23

move beyond concepts of sedentism and mobility to consider a flow of life, a patterned choreography of occupation. We can think of that in terms of the idea of conviviality, borrowed from Amazonian ethnography, but appealingly suited to the evidence for daily existence and small-scale, domestic existence. In this aesthetics of existence, people were rooted in but not confined to particular places. Chosen place may have been the centre of social existence, the locale both for much of daily life and occasional gatherings. On a routine basis, people also moved through their taskscapes doing things in the right way, respecting and skillfuly using their surroundings. On a perhaps less routine basis, people may have moved much further afield, or were certainly in touch through raw material movements or exchanges with a much wider world. This sense of connectedness may have been important in the formation of identity or personhood, and finds expression also in other relations with past, earth and animals.

In his much earlier ethnography of the Körös culture, János Banner presented a view of very active and resourceful people in practical terms, engaged in a multitude of tasks (Banner 1937). That is a vision I share, and many of the details suggested by Banner can be supported and amplified by the evidence produced by the Ecsegfalva and other recent projects *(Fig. 32.5)*. I have differed from his account in speculating more widely on the nature of the sociality of the people involved, and in stressing their agency. In conceptual terms, Banner thought of these people as more driven than I do, fearful before the power of natural forces and events beyond their comprehension. He was perhaps right not to reproduce the people of the Körös culture as just like us or any other analogue from the modern world, but in emphasising the choices involved in this way of life I believe that we end with a rather different sense of agency to that implied by Banner. I want go on now, finally, to look at that agency from the perspective of beginnings, site abandonment and later developments in the region.

Context: beginnings, abandonment and what came after

Beginnings

What can the investigations at Ecsegfalva 23 tell us about the conditions under which the way of life which it embodies began? We need, first, to sort the question of chronology, and that is still far from easy. The Körös culture *qua* archaeological culture does not lend itself to easy internal phasing. The suggestion that white-painted pottery at Szarvas 23 shows an early site (Makkay 1981) has yet to find independent support. The difficulties of using biconical pottery as a marker of late developments have been extensively discussed by Krisztián Oross above (chapter 27). In this situation, the best guide to sequence is given by radiocarbon dating. Dates obtained from other Körös and northern Starčevo sites suggest that Neolithic sites first appeared in northern Serbia at the end of the seventh millennium cal BC and in southernmost Hungary around 6000 cal BC or just after (Whittle *et al.* 2002). Compared with this pattern, the dating of Ecsegfalva 23 to the 58th and 57th centuries cal BC appears at face value to indicate a site that belongs to a period some generations after the appearance of a new way of life. On that basis, the Ecsegfalva project could be seen as having little direct relevance to the questions of beginnings and origins. On the other hand, Ecsegfalva lies sufficiently further north (some 100 km) of the sites dated from about 6000 cal BC, such as Deszk, Maroslele-Pana, Hódmezővásárhely and Pitvaros, for a gradual northward spread, perhaps largely confined to the Tisza corridor, to be plausible. We simply do not know enough about sequence in the northern portion of the Körös culture to be able to say whether it really began c. 6000 cal BC, or in fact only at about 5800 cal BC. It may be relevant that the other two more northerly dated sites, Szarvas 23 and Endrőd 119, do not appear to be earlier than c. 5800 cal BC. There is only one date from Szarvas 23, but nine dates from

Endrőd 119 fell between c. 5800 and 5650 cal BC (Whittle *et al.* 2002). Here is a clear goal for future research: to obtain more radiocarbon dates on well contexted samples which will fill out this regional picture, including from the sites on the Pleistocene alluvial delta around Dévaványa not far to the south of Ecsegfalva 23 (Sherratt 1983b).

We cannot discuss process without secure and detailed chronology. So on this more gradualist chronology, sites like Ecsegfalva 23 could be relevant to the initiation of change. Clearly, the overwhelmingly favourite explanation in the literature is of some kind of colonisation from the south, bringing new people, new resources, new technologies and new ways of thinking to what had been up till now, in this part of the Carpathian Basin at least, a more or less empty landscape, devoid of obvious indigenous inhabitants. A recent suggestion is of 'leapfrog' movement, jumping from one favourable niche to the next, and serving to accelerate the colonisation process (van Andel and Runnels 1995; Biagi *et al.* 2005, 48).

Many of the colleagues involved in the analysis of Ecsegfalva 23 would subscribe to this general notion of innovation from the south, to account for the introduction of the new practices of cereal cultivation, animal husbandry (especially the perverse tradition of keeping sheep in the conditions of the Great Hungarian Plain) and pottery manufacture and use. The use of rectangular buildings can also be more easily traced to the south than to the indigenous north. The apparent general absence of a local population, the presence of Mesolithic or Epipalaeolithic sites in the Jaszág to the north of Szolnok notwithstanding (Kertész 1996), seems for many observers to clinch the matter.

Was it so simple? The Körös basin did not exist in isolation, and I accept that a key part of its history at this time owed much to the south. If important resources and practices came from the south, and from well established traditions there, there are indeed good grounds for thinking of population movement as well. But was the Plain really empty at this historical juncture? There are hints from earlier dates from Topole-Bač, Maroslele-Pana and Ecsegfalva 23 (Whittle *et al.* 2002; Borić 2005; Bronk Ramsey *et al.*, chapter 10 above) that there were indeed people present on the Plain at earlier times, in the seventh millennium cal BC, and some of the features of the pollen sequence might also be consistent with this earlier presence (Willis, chapter 6). We are not good at modeling low-density presences, and bad at thinking about ephemerality and episodicity. The obsidian network testifies to the reality of movement even when very few sites can be documented on the ground between raw material sources and recipient sites. So it is feasible after all to think of pre-existing indigenous knowledge of the Plain, based on high mobility radiating out from more frequented areas such as the Jászság or the Tokaj-Zemplén hills to the north-east. Such knowledge may have been incomplete (Kelly 2003) but still sufficiently adequate to suggest where to go in the contingency of changing circumstances around 6000 cal BC.

Inna Mateiciucová has stressed the importance of the 'Danubian' traditions of lithic raw material procurement and treatment (chapter 31; 2001; 2004). While technologies can be transferred or emulated without corresponding population movement, it seems perverse to deny the involvement of actual people in the case of lithic technology transfer while readily accepting it in the case of ceramic technology. We are a very long way from understanding the genetic composition of these ancient populations, but inferences from modern populations, from both male and female lines, do allow us to think of a proportion (perhaps a significant proportion at the very least) of indigenous stock (e.g., from a much larger literature, Richards *et al.* 1996; King and Underhill 2002).

If we allow agency, history is not predetermined. The present is always contingent. Some people made their way up from the south, perhaps rather more slowly on the Great Hungarian Plain than in other regions to the south, and without obvious leapfrogging here. They began to encounter a rather different setting. The Kiri-tó might seem a rather odd location for migrating farmers to end up in. Other people, indigenous, mobile, experienced and knowledgeable, and perhaps takers of opportunities (in Bird-David's terms: 1990), became aware of others, newcomers, through smoke on the horizon, or traces and glimpses of strange new animals. Contact was established, as it always is. Indigenous people could see the possibilities of doing things differently to their own past practices. They knew where to go, and understood the natural rhythms of local places (or enough of them). They knew of the distant raw material sources.

In this scenario, people would have intermingled, and rather than having to choose between colonisation and acculturation, we can think of some kind of fusion. In this discussion, I have used the terms 'Mesolithic' and 'Neolithic' sparingly. We need to get away from the predetermined and essentialised characterisations of people that those terms so often carry with them. Instead, we can emphasise agency, choice, and practice. We can think of the pushes and pulls of tradition and tactical flexibility, of the lure of the novel in competition with the familiar, of the opportunities for new forms of sociality and the costs of maintaining old ways, of the risks of thinking new worlds into existence against the securities of the story so far. We can, as it were, throw all this up into the air and see what comes down (Bailey and Whittle 2005). We do not, literally and metaphorically, have to take sides. We can think of frontier situations as melting pots for the formation if not transformation of identities (Kotsakis 2005; Borić 2005). We may even resist the notion of frontier as once again predetermined, essentialist, anachronistic. *At the time*, these were the actors in their particular historical situation, and the outcome of their varied and ongoing choices was the way of life which I have tried to characterise above: small-scale, engaged, intimate, partly rooted, partly on the move – and above all different.

Abandonment

As I have suggested above, there may in the cycle of occupation at Ecsegfalva 23 have been more than one abandonment, though without more extensive excavation we cannot be sure. I want next briefly to discuss the final abandonment of the site. In the present state of knowledge, it is hard to think of this as more than a local event, perhaps socially determined. There is no obvious sign from the pollen record or from the character of resources that there were factors leading to overuse, pressure or decline. The region continued in use in the AVK, and the general picture is of a shift from sheep to cattle keeping (see Bartosiewicz above, this chapter). We know very little about the period between c. 5650 and c. 5500 cal BC, when the AVK appears to have begun, and so we cannot see in any detail yet when that shift began, and whether people had already begun to tire of the Balkan tradition of sheep keeping by the 57th century cal BC. Likewise, there is insufficient evidence for the history of cereal cultivation to know whether gardens declined in performance at this time, and certainly the cereal curve in the pollen diagram from the Kiri-tó does not appear markedly affected at this juncture (Willis, chapter 6).

So perhaps we have to turn, speculatively, to some other kind of dynamic. People leave places for a host of reasons other than purely economic: when they sense that habitations are dirty or infested, to escape neighbours or to get closer to allies, or on the occasion of a significant and perhaps polluting death (Whittle 1997). Perhaps the evidence for burning could suggest the latter kind of possibility, bringing a deliberate end to the occupation of this place. Reinforcing that, the place was not used again till the AVK, for a little occupation and the burial found in Trench 23A, and even then the local picture appears to be of a shift along the south side of the Kiri-tó, leaving Ecsegfalva 23 as a locale known but best avoided for its old spirits.

This is relevant to thinking about the broader picture of what came after. The immediate implications are that, first, the local situation was not static, but secondly, is unlikely to reflect a period of marked growth or expansion. If that is so, and there are around another 150 years for subsequent change to take place, it is unlikely that the Körös culture was directly involved in the emergence and development of the LBK, in Transdanubia and beyond (most recently suggested by Otte and Noiret 2001). That is far more likely to be the result of complex processes of interaction between late Starčevo and late Mesolithic communities in Transdanubia and to the north, with the LBK emerging c. 5500 cal BC and spreading initially quite rapidly along existing networks of interaction and exchange (Gronenborn 1999; Whittle 2003; Bánffy 2004; Mateiciucová 2001; 2004; Lukes and Zvelebil 2004; Willis, chapter 6).

The situation in Transdanubia was perhaps rather different to that on the Great Hungarian Plain. It can be seen as marked by a relatively low density of late Starčevo culture settlement and by a very elusive late Mesolithic presence (Bánffy 2004). That combination may have been enough to trigger the conditions and circumstances of contact from which longhouse life emerged (Whittle 2003). Things seem to have been different on the Great Hungarian Plain. At least in the 58th and 57th centuries cal BC, occupations were more numerous, and there was contact with indigenous populations to the north. Further change did come on the Plain, the AVK culture taking settlement right up to the north of the Plain. While the pattern of waterside occupation probably did not much change from what had gone before (Kosse 1979; locally, Ecsedy *et al.* 1982; Jankovich *et al.* 1989), there was a shift to an emphasis on cattle keeping (Bartosiewicz, this chapter) and longhouses have now been documented in the north of the Plain (Domboróczki 1997). Research on the transition from the late Körös culture to the AVK appears to have become snagged in culture historical questions (the phasing and constituents of the Szatmár group, for example), whereas this higher-density situation could more profitably be compared and perhaps contrasted with what was going on in Transdanubia and beyond.

So while the abandonment of Ecsegfalva 23 c. 5650 cal BC was probably only a local event, what came after is very relevant to wider questions of change through the Plain as a whole. Here is another goal for future research. The character of the environmental setting has been established and the outline of a sequence constructed; AVK sites are known locally. When Ecsegfalva 23 had been left to ghosts and spirits of the dead, were people living in a longhouse on the next ridge along the Kiri-tó, and how did the sociality and conviviality of longhouse life here compare with what had gone before in the days of the Körös culture? As the AVK woman buried in Ecsegfalva 23 patiently worked sinew against her front teeth, did she see the world differently to her forebears?

Other ways of telling: homage to János Banner

...we come and go, there is little honour in sitting still...

...tended fire, safe house; safe house, tended people...

...and it was a great meeting. When the South Ones came up and the North Ones came down, they met where the waters went down, leaving the ring of water. They recognised each other by the prints of feet in the mud. That is why we cover our pots with signs...

...green waters, happy days...

...sheep are the sound of our ancestors...

...bread for business, lamb for pleasure, milk for choice...

...sheep are for everyday, sheep are the everyday. They follow us, and we follow them. But the Great Deer comes and goes as he pleases. Some say he is the spirit of the place but others say he is the place, the First One, who walked and walked from who knows where and brought this world into being. Rarely do men hunt him, it can be bad luck to use his bones...

...to build a house, you must first dig. Digging makes that place, that house-to-be. At the end of the house, the house-hole should be filled, to bury past lives and to restore to the earth what belongs to the earth...

...most men are lazy. After clearing the bush, they like to sleep. It is the women whose backs ache in the gardens. A good woman is a good cultivator, a good cultivator earns respect...

...in those days there was plenty. We were not often hungry. Bountiful nature gave us everything. Most of all we liked to eat and drink with others, banishing the lonely times...

...the black stone comes from far to the north. The First Ones left it on the hillsides, when they camped. We go by the rising sun in summer. Boys learn the best way from their fathers or uncles. To cut with the black stone brings good fortune to men and women alike...

...a great death cannot be concealed. The talk spreads as quickly as rising water, among the herders and hunters, among the women in the gardens. And the end is for all to see, when the smoke rises from the burning house, and all must see. We fear those days of fire, but the dead spirit flies free...

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